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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Forthcoming Events.

JANUARY 17.

Sheffield Metallurgical Association:—Ordinary meeting. "The Chemical Engineer and the Steel Maker," Paper by J. L. Pearson, B.A., Ph.D., M.Sc., B.Sc.

JANUARY 18.

Institute of Metals (Swansea Local Section):—Meeting at Swansea. "Some Interesting Properties of Alloys of Nickel," Paper by W. T. Griffiths, M.Sc., F.I.C.

JANUARY 19.

Institute of Metals (Birmingham Local Section):—Meeting at Birmingham. Paper by T. Henry Turner, M.Sc., on "Heat Resisting Alloys." Joint programme arranged by the Birmingham Metallurgical Society, the Staffordshire Iron and Steel Institute, and the Birmingham Local Section of the Institute of Metals.

Institute of British Foundrymen.

JANUARY 14.

Lancashire Branch (Junior Section):—Ordinary meeting at Manchester. A lecture on "Cast Iron," by F. J. Cook, M.I.Mech.E.

Wales and Monmouth Branch:—Ordinary meeting at Newport. "Jolt Ram Machines for Jobbing Work," Paper by A. L. Key.

West Riding of Yorkshire Branch:—Ordinary meeting at Bradford. "Further Notes on Oil Sand Mixtures," Paper by W. West.

Newcastle Branch (Junior Section):—Visit to the works of the North-Eastern Marine Engineering Company, Limited, Wallsend, also a talk on "Special Cast Irons," by C. Gresty.

Scottish Branch:—Ordinary meeting at Glasgow. "Diesel Engine Castings," Paper by A. J. Richman.

JANUARY 21.

Lancashire Branch (Burnley Section):—Annual social at Burnley.

Great Britain's Place in the Sun.

For some time there have been pessimists ready to proclaim that England's day of industrial supremacy is over and that she must now be content to take a back seat. Whether or no there be any foundation for such gloomy prognostications, we who are concerned with industry simply cannot afford to listen to such a view, and, indeed, it would be hard to find practical men who give it the least serious consideration. To us the troubles of the past few years form a period of unparalleled and prolonged distress and difficulty, but one from which we shall inevitably recover sooner or later—though by this time we are beginning to wish most emphatically that it would be sooner.

It is therefore disquieting to find that the view which to us represents the height of pessimism is implicit in much that is being said and done in other parts of the world. The United States and the Dominions are the chief offenders in this matter. In the case of the United States, the extension of her export trade in the heavy industries postulates, if not the actual supply of such goods to us, at least the winning of many markets formerly regarded as primarily ours. From us she is prepared to buy culture, tradition, history, embodied to some extent in certain types of manufactured goods. The recent report on economic conditions in the States says plainly that we cannot hope for any serious extension of the market for our heavy goods there, although articles in the making of which individual taste and finish plays a large part—goods, in other words, which are acceptable chiefly because of the cultural and traditional environment from which they come—are readily saleable. Fishing tackle made by a well-known English firm falls within much the same category as a motor tour round the Shakespeare country, and is poor compensation for the gradual loss of markets for our heavy goods to which we seem to be doomed by American development.

As for the Dominions, it is hard to resist the conclusion that what their commercial demands really mean is that we are to help them to develop into potential rivalry the very industries on which we ourselves depend for prosperity. We are assured that, of course, they would "stick to the old country," that she stands for too much and is too valuable to them to be allowed to go under in the commercial struggle; but one fears lest her value and significance to them should become primarily sentimental and traditional—much as it seems to be becoming to the United States.

It may be remarked that other countries have flourished on the basis of natural or artistic beauties as their main saleable commodity: but it is necessary to remember that the outstanding examples, Switzerland and Italy, have of late years begun to develop at a considerable rate into industrial powers. To reverse the process and replace our prized industrial supremacy by accepting a sort of Chelsea pensioner seat among the nations might be very pleasant for other English-speaking people, who would be assured thereby of an agreeable holiday *milieu*, complete with historic monuments and universities; from our own point of view it is unthinkable, and the sooner we take advantage of the growing signs of trade revival and prove to the world at large our unwillingness to aquiesce in any such arrangement the better.

Can It Be Done?

The Michigan State College has decided to institute a course of metallurgy for engineers which will not treat of the extraction and melting of metals, but rather of the selection and inspection of alloys. Candidly, we are not impressed with the scheme, or, indeed, any other phase of scholastic activity which pretends to provide industry with a ready-made manager. The late Prof. MacWilliam, of Sheffield University, often told graduates that if they realised what they had to learn in the future, the department had fulfilled its purpose. It is puerile to imagine that technical colleges can teach a man his job, because it is impossible to standardise on the technical requirements of any position filled in after life by the graduate. It is highly probable that when a graduate occupies a job that matters, his professional knowledge will occupy something between 1 and 5 per cent. of his thought output. If an examination were made of the subjects to which an important executive devotes his mental energy and these were catered for in a University curriculum, then the major part of the student's time would be occupied with matters only ancilliary to his studies. Thus we feel assured that technical colleges would be well advised to adhere to stereotyped courses which experience has shown puts students into a receptive mental attitude which is so desirable when they receive industrial appointments. We think that efforts to produce curricula designed to instill the definitely applicable knowledge required by all the various phases of industry should be discouraged. An adequate grounding in one of the major sections of either engineering or metallurgy, as given by the British Universities, forms a splendid jumping-off ground for people who realise that they still have to learn and not to teach. To return to the query in the caption, scholastic institutions can never hope to turn out ready-made departmental managers for all the various sections of industry, and simplification rather than complication in the ground to be covered by a course will be of greater service to industry generally.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cupola Melting.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We read the article on "Cupola Melting, with Special Reference to the Value of Steel Scrap in Cupola Mixtures," which appeared in your issue dated December 29, 1927, with considerable interest. We think that Mr. Dennison's picture of the foundry cupola as a naturally provided governing device compensating the errors in foundrymen's mixtures would have been very much altered if he had included the element sulphur in his calculations.

We are glad to find that in the end Mr. Dennison agrees with us, if only in connection with steel mixtures, that "the balance of the mixture must be carefully selected."

We insist that wherever a mixture is of sufficient importance to necessitate its components being carefully selected, then the use of refined irons is justified and in fact desirable.—Yours, etc.,

per pro Bradley & Foster, Limited,
G. T. LUNT,
Director.

Darlaston Blast Furnaces,
Darlaston.
January 3, 1928.

How a White-Metalled Bearing Wears.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your report of a Paper by Mr. A. J. Richman he is alleged to have stated that there is a comparison to be made between the resistance to wear of a cast-iron cylinder-liner and that of a white metal bearing (babbit metal). Further, he states that the resistance of the latter is due to the two hard constituents "taking care of the wear."

I cannot see that legitimate comparison is possible between a cast-iron cylinder-liner and a white-metalled bearing; nor can I agree with Mr. Richman's conception of the manner in which a white metal stands up to service.

White-metalled bearings are—so far as I know—lubricated properly. A film of oil always exists between the white metal and the other metal present. Actually they should never touch, and a breakdown of the oil film results immediately in damage to the bearing. Direct rubbing between the white-metalled portion and the other metal never occurs so long as the bearing is functioning satisfactorily.

To my mind, the properties of a white-bearing metal depend upon, firstly, its facility to conform to the shape of the bearing when working; secondly, its power to keep solid under such conditions, which property is enhanced by the hard constituents acting as reinforcements and supports to the softer matrix; thirdly, its ability to form and to maintain a "skin" of such nature as encourages a continuity of the oil film and flow; next, the softness and weakness of such particles of it as may be set free; and, lastly, the lack of "stickiness" between it and the other metal, while the skin is forming in its early life or during any momentary absence of that skin afterwards.

The conditions under which wear can take place in a lubricated bearing need a great deal of visualising I have thought always that the "skin" of the metal plays the principal part and not the metal itself as a mass.

Practically also come in questions of strength, resistance to impact, conductivity, and so on, but here I speak solely of wear. It will be remembered that wear-testing machines have given most unreliable results, and, undoubtedly, wear tests should be conducted under service conditions.

The above remarks, about white-metalled bearings, apply as long as there is perfect lubrication, absence of corrosion, or burning, of too high temperatures for the metals concerned, of collections of abrasive particles metallic or non-metallic, of the erosive action of gases and of wide differences of temperature. Unfortunately, those portions of a cylinder-liner with which engineers are most bothered cannot be said to live their lives under conditions similar in any way to a white-metalled bearing which itself seems to me to break down directly it experiences treatment such as is suffered by a cast-iron cylinder-liner.

The subject is interesting, and I shall be glad if Mr Richman will answer my letter by setting forth his ideas as to how a white-metalled bearing wears, and why he sees similarity between its wear and that of a cast-iron cylinder-liner. Engineers also might join in the discussion and point out the fallacies in our theories "as to how a white-bearing metal wears—*if it does.*—Yours, etc.,

HORACE J. YOUNG, F.I.C.

3, Central Buildings, Westminster,
London, S.W.1.
January 5, 1928.

Coke Ratios.

To the Editor of THE FOUNDRY TRADE JOURNAL.

DEAR SIR,—I have read with great interest the article on coke ratios in the current issue of your journal, but I am afraid the author is a "Prophet crying in the wilderness" as my experience of foundries in this country the number who weigh their coke charges could be counted on the fingers of one hand.

It is a most extraordinary state of affairs when one considers it—on one side one hears complaints of bad trade and orders being taken at a loss whilst on the other side one knows that not the slightest effort is made to reduce the amount expended on fuel unless it be an occasional trial wagon of coke from another source of supply usually because it is a shilling or two per ton cheaper and which works out in the end several shillings per ton dearer.

I could give quite a large number of instances of the vast amount of waste of money in fuel which is taking place in foundries all over the country, but will content myself with citing three: No. 1.—A very large foundry making light castings. Here they buy veritable rubbish as their main supply and use quantities of a better grade to help the cheap coke burn. No. 2.—Also make light castings, and in this case the bed is made nearly up to the charge door and no amount of argument will induce the management to see that until the surplus coke has burned away no melting takes place. No weighing of the charges is done. No. 3.—Light castings makers requiring very hot metal. Use a certain coke because the first cost is somewhat lower than a better grade, which, did they but know it, would effect an economy in the neighbourhood of 25 per cent. in fuel alone, not to mention other economies that could be effected by better fuel.

Some of our British foundrymen should visit German establishments when possibly they would have their eyes opened to the useless waste in fuel taking place in their own foundry at home. —Yours, etc.,

KOHLENSTOFFE.

January 6, 1928.

A.C.I. Shoot.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Referring to the article by "Sprig" in this week's FOUNDRY TRADE JOURNAL, it would seem that much unnecessary time and labour was spent on this job.

In the first place, drag and core were built in loam, a process quite unwarranted by the size of the mould. This, besides occupying more time than the sand method, involved stoving twice before the final drying took place.

A more suitable method is as follows:—After setting the spindle the drag is rammed and the cone swept to *outside* size in sand. This is covered with parting sand, and the loose strips placed in position.

When the mid-parts are removed the strickle is set to *inside* size and the thickness removed. The mould can then be finished, blackened and dried.

By this method no halt is made from the time of starting to the stoving of the finished mould.

Yours, etc.,

"SEESTU."

January 7, 1928.

Patent Specifications.

The following list of Patent Specifications Accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

22,883. KIRCHHOF, A. Process of treating aluminium for the purpose of rendering it weldable. September 16, 1926. 278,164.

30,094. MAXIMOFF, J., COSTA [née VINCENT], M. S. DE, and KREBS, R. P. D. [known as GALLICANNE, L.]. Method of and apparatus for refining steel and pig-iron. (November 28, 1925.) 262,136.

10,801. DOHNER, O. H. Process for the production of sheets, bands, wires, etc., from ferro-silicon alloys for the improvement of their electrical properties. (September 4, 1926.) 276,953.

16,021. BURY, E. Process for the treatment of zinc waste. (March 24, 1927.)

16,538. HOPFELT, R., AND NOLDEN, C. P. Process of coating metals with aluminium or magnesium or their alloys. July 1, 1926. 278,415.

18,096. MARTIN, W. E. Machine for polishing metal sheets. July 20, 1926. 278,462.

21,622. KRUPP AKT.-GES., F. Treating low carbon-steel and irons. (July 7, 1926.) 274,016.

597. CROAD, A. K. (Sand Spun Patents Corporation). Centrifugal metal-casting machines. Jan. 8, 1927. 278,560.

4,262. NEW JERSEY ZINC CO. Metallurgical operations. (March 25, 1926.) 268,302.

7,967. BUDD WHEEL CO. Processes of rolling metal discs. (March 31, 1926.) 268,762.

15,933. SOC. ANON. METALLURGIQUE D'AUBRIVES ET VILLERUPT. Centrifugal casting-machines for the manufacture of cylindrical hollow bodies. (July 20, 1926.) 274,830.

17,261. JACOBSEN, J., GOFFIN, J., GOFFIN, L., and RENSON, L. Recovering tin from tin-plated materials. (July 9, 1925.) 255,092.

17,770. RAMEN, A. Process for chlorinating ores. (July 15, 1925.) 255,475.

1,508. BUDDEUS, DR. W. Process for reducing ores. (Jan. 20, 1926.) 264,834.

4,641. GEWERKSCHAFT SACHTLEBEN, and KUPPERS, J. Rotary furnaces. (March 24, 1926.) 268,308.

7,536. KRUPP AKT.-GES., F. Sintered hard metal alloys and articles manufactured thereof. (Oct. 25, 1926.) 278,955.

17,063. CORBIN, F. D., LLANELLY FOUNDRY AND ENGINEERING COMPANY, LIMITED, AND NEVILL & COMPANY, R. Rolls for rolling metals. July 7, 1926. 279,149.

18,035. POWELL, A. R., DEERING, E. C., AND JOHNSON, MATTHEY & COMPANY, LIMITED. Processes for extracting metals. July 19, 1926 279,156.

22,987. KLEIN, C. A., AND BROWN, R. S. Treatment of ores containing titanium and iron. September 17, 1926. 279,219.

24,715. NILSON, G. E. R. Process for the manufacture of low-carbon metals and alloys. (October 22, 1925.) 260,232

27,924. WEISHAN, B. Process for the production of soft-iron. (September 29, 1926.) 278,303.

31,749. SMITH, W. Process for impregnating metals with aluminium and aluminium alloys. December 14, 1926. 279,273.

12,662. BUHRMANN, H. Process for superheating blast furnace and cupola furnace slag and the addition of certain lacking constituents. (May 11, 1926.) 271,087.

14,414. JENSEN, E. JORGEN-. Production of castings under pressure. (March 22, 1927.) 279,345.

16,154. GWILLIM, J. Devices for cleaning the rolls of roller mills. June 17, 1927. 279,358.

23,809. DAVIS, A. F. Firebars for furnaces, and bearers therefor. September 27, 1926. 279,604.

32,535. KOHLSWA JERNVERKS AKTIEBOLAG. Manufacture of steel. (December 23, 1925.) 263,811.

5,560. MOND, A. L. (Metallbank und Metallurgische Ges.). Method of sintering, desulphurising, or removing volatile constituents from ores. February 28, 1927. 279,693.

6,618. COMPAGNIE DES METAUX OVERPELT-LOMMEL. Reduction of zinc ores. (January 26, 1927. 279,697.

26,574. THOMAS & COMPANY, LIMITED, R., AND JONES, E. A. Machinery employed in the manufacture of tinplates. October 25, 1926. 280,025.

19,772. BROWN & SONS (HUDDERSFIELD), LIMITED, D., AND BROWN, D. Centrifugal machines for casting metal. August 11, 1926. 280,280.

19,952. FIRTH, J. C. B., AND DICKINSON, F. G. Devices for testing the hardness of metals. August 12, 1926. 280,292.

Some Points About Electric Metal Melting.

Mr. John T. Goodwin, President of the Institute of British Foundrymen, was present at the December meeting of the Scottish Branch, held in the Royal Technical College, Glasgow. MR. GOODWIN, who was introduced by the local President, Mr. Tom Bell, said that that was his first visit to them as President. He had been informed that the Scottish Branch showed a growth in membership of 14, and that they had started a Junior Section. That was good news. He urged them to try and keep these new members, and to increase their membership still further if possible. In regard to the finances of the Institute, he was pleased to report a wonderful response to his appeal for economy.

Mr. Goodwin then presented a diploma to Mr. J. W. Donaldson for his Paper on "The Growth of Cast Iron." In Mr. Donaldson, he said, they had a very hard working member, and one who did a great deal not only for his own Branch but for other Branches. He thought Mr. Donaldson's work had culminated in the excellent Paper he had given.

MR. DONALDSON, in reply, said he appreciated very much the honour the Council had done him. It had just occurred to him that it was ten years since he had prepared his first technical Paper. At that time he knew very little about cast iron, and he consulted Dr. McCance, who suggested that he should prepare a Paper on special elements in cast iron. Since then about two-thirds of the research work he had done had been on cast iron.

Electric Furnace Practice.

Thereafter a Paper on "Electric Melting Furnaces" was read by MR. VICTOR STOBIE, A.M.I.E.E., of Newcastle. Mr. Stobie said that many Papers had been given on this subject, so he had decided to touch lightly upon matters reviewed elsewhere, and to deal only with some special points. As they knew, electricity was converted into heat when a resistance which could not completely stop it was put in its path. An example was the ordinary electric light lamp. The high electrical resistance of the wire prevented the passage of most of the current which would otherwise flow through it, and the opposition given to that which did flow through was such that the heat caused by the fight raised the wire to incandescence. In an electric arc lamp the air of the gap between the two carbons formed the resistance. The intensity of the arc was a sign of a greatly localised resistance at the gap; the arc in fact usually contained the major portion of the energy in the current which reached the lamp.

The temperature of the arc depended upon two factors. One was the chemical nature of the air or gas which filled the gap where the arc was formed, and the other was the nature of the carbon or other electrodes between which the gap lay. The temperature of the arc of the old-fashioned arc lamp with plain carbon electrodes was about 3,500 deg. C.—something more than twice the temperature of the hottest molten steel. The quantity (as distinct from temperature) of heat at the arc varied with the quantity of current forced through it.

Arc Temperature and Quality.

In an electric arc steel melting furnace the arc was produced, except at the first moment of starting, in an atmosphere of heated and therefore rarified air containing particles of iron, carbon, and other conducting materials and gases. The temperature of the arc was not so high as in an old-fashioned arc lamp, because the gases which composed the arc-gap resistance in an electric furnace had a lower resistance. They might assume the temperature of the arc to be somewhere between 2,500 and 3,000 deg. C. It had at times been suggested against the electric furnace, when used for melting steel, that the intense heat of the arc spoiled the quality of the steel; but he had never known any admittedly well-made electric steel produced at a somewhat high temperature which gave any test result different from other heats of similar steel made at a lower maximum temperature. If any electric steel gave good results on test—and they knew that most of it did—then it could not be said that the heat of an electric furnace automatically spoiled steel. What was important, however, was that electric steel, like all steels, should not be cast at too high a temperature. They knew that iron existed in the sun, and that every material forming the earth had at one time been at the same intense temperature as the same substances in the sun to-day. If the solar temperature of some three times that of an electric furnace had not already spoilt their iron, the heat of an electric furnace was quite incapable of doing so. Furthermore, electric steel was never raised more than 50 deg. above open-hearth steel. The arms of the furnace never touched the molten steel except by accident, as the steel was covered by its slag blanket, which was electrically conductive. The slag formed the bath end of the arcs, and passed the current on to the steel by ordinary solid conduction.

He had found invariably that any original defect in an electric steel could be traced either to the conduct of the melter or to the general history of the heat. Nothing which need go unseen or be uncontrollable happened in the course of making electric steel unless, of course, an exceptional electrical or structural accident supervened. Even such accidents were all of an observable nature, though not necessarily remediable during a particular heat, just as would a breakdown of a cupola blower. A modern electric furnace was controllable in every detail of chemical, physical and electrical happening, and to-day a proficient hand could, without hesitation, give a substantially correct forecast of the quality of the steel produced by the time it had been cast. He did not know any other steel-melting process where this obtained.

The heat for melting, being obtained solely by the conversion of electrical energy, was, of course, free from sulphur and other undesirable constituents, and, when considering the chemical actions and reactions of electric steel as compared with those taking place in an open-hearth furnace, this fact should be kept in mind, as otherwise one or two of the claims made in favour of electric steel might appear extravagant.

The Melting Process.

The raw material for melting consisted of steel turnings, or whatever scrap happened to be cheapest in the district. No pig-iron was necessary. Sufficient lime and iron ore, or mill scale, was added to the furnace charge to form a slag and to oxidise the carbon, silicon, manganese and phosphorus present in the scrap when melted. These elements then passed out of the molten metal, partly into the slag and partly into the atmosphere. Samples of the molten metal were then cast into small chill moulds and sent to the laboratory for analysis. As soon as the analysis showed that the bath was refined, and if a good heat was on the metal, the furnace was tilted, and the first slag poured off. An analysis of the bath made just before the slagging should reveal a metal approximating a pure iron, except that it contained combined oxygen and most of the sulphur in the original scrap.

Refining Conditions.

Preparation was now made to add the necessary quantities of carbon, ferro-silicon, and ferro-manganese to de-oxidise the bath and give the desired final composition. These were thrown on to the bare metal with the final slag, which consisted, approximately, of 60 per cent. lime and 20 per cent. fluorspar. The steel de-oxidised under these conditions, and the sulphur was automatically reduced to a trace, according to the following reactions. These reactions were peculiar to the electric furnace, and the high quality of electric steel proceeded mainly from them. The greater part of the de-oxidation of the bath resulted from the addition of ferro-silicon and ferro-manganese, as in the other steel-melting processes. The last trace of oxygen left in combination, which could not be removed in any but an electric furnace, was acted upon by the slag, which had itself first been purged of all iron oxide by carbon additions. Under these conditions, and at the temperature of the electric arc, the following reactions took place:—

$$CaO + 3\,C = CaC_2 + CO.$$

The calcium carbide thus formed in the slag attacked the iron oxide at the surface of the bath with the following result:—

$$CaC_2 + FeO = CaO + Fe + 2C.$$

The reduction of some of the silica in the slag by the carbon under the arc also helped the de-oxidation of the bath, as follows:—

$$SiO_2 + 2C = Si + 2CO.$$

This enabled the silica to combine with iron oxide as follows:—

$$Si + 2FeO = SiO_2 + 2Fe.$$

When de-oxidation was complete the silicon content of the steel tended to increase by reason of the continued reduction of silicon from the slag. Manganese oxide, rising from the bath into the slag, was also reduced by the carbon under the arc, and the manganese returned to the steel, repeating these up and down journeys until the oxygen in the bath was below the value that manganese would attack. The calcium carbide in the slag was also instrumental in abstracting sulphur from the metal, as follows:—

$$CaC_2 + 2FeS = CaS + Fe + 2C.$$

Manganese sulphide was similarly decomposed by the calcium carbide. The actual reactions were more complex than those he had given, but the essential causes and results are as given.

During the latter stages of a heat the bath was rabbled to aid the uniform distribution of the constituents of the steel. When samples of steel taken from the furnace solidified quietly the steel was free from combined oxygen, and was ready for tapping as soon as the chemical tests revealed the desired final composition. It was interesting to note that, according to Dr. McCance, oxygen in solution existed in electric steel to the extent often of twenty volumes per volume of steel, while in other steels the figure was 80 to 120 volumes per volume of steel.

Electric steel offered several pronounced advantages over other steels when used for castings. It lay quieter in the moulds than either converter or open-hearth steel. The result was that less sand was attached to the skin of the casting, and pulls were much less frequent. The comparative freedom of electric steel from sulphur was an excellent help against cracks in castings. It also permitted a shorter annealing process. An interesting characteristic of electric steel compared with crucible or open-hearth steel was that it would maintain a greater toughness for a given carbon or chromium content; therefore, the greater resistance to shock, abrasion or blunting effort brought about by an increase in these elements was not, within limits, accompanied by an increase in brittleness.

In the realm of iron founding the electric furnace had not yet made its name in this country. There were many electric furnaces working on cast iron in other parts of the world, and one would like to know why greater progress was not made in this direction in Britain. In America the electric furnace was used for grey-iron castings, cylinder work, malleable castings, and the super-heating of iron. At his own works synthetic pig-iron in large quantities and grey-iron castings up to eight tons in weight had been made by means of the electric furnace with great success. The synthetic pig-iron, however, was commercially feasible only during the war, on account of the shortage of special irons then. The production of iron for malleable-iron castings was undoubtedly a splendid opening for the electric furnace. One could appreciate the ease with which a composition of iron demanding the shortest malleablising could be produced in an electric furnace. Malleablising was such an expensive proceeding that a shortened process with an ideal composition of iron should more than pay for the extra cost of electric melting.

A recent discussion on electric steels arising out of a Paper given before the London Branch of the Institute had brought forward two suggestions which he would consider. One was that aluminium did not deoxidise ferrous material. The electric

furnace, he submitted, offered the reply. Before the best method of producing the synthetic pig-iron already mentioned had been decided, the process consisted in feeding a bath of molten steel with anthracite until it had combined with about 3 per cent. of carbon. One might have expected that such an addition of carbon would thoroughly deoxidise the bath. Samples taken from the furnace, however, showed large bright cavities when cast and fractured. Some aluminium was added to the bath, and instantly fresh samples were found to be free from the cavities. It would be difficult not to accept this as proof that the action of the aluminium was that of a deoxidant. If the aluminium only caused the oxygen to change from being in combination to being in solution, it was still, from the metallurgist's point of view, a deoxidant.

The other suggestion was that electric steel was less fluid—perhaps more viscous was a better expression—at a given temperature than other molten steels, in consequence of slag inclusions. It was also hinted that probably there was more slag inclusion in electric steel because of the quietness of the molten bath in the furnace. As both these premises might lead some to believe that electric steel had inherent defects, and as they were contrary to his experience, he would deal with them.

In Glasgow a large cylindrical forging, 16 ft. long, made of electric steel was used for tests to ascertain the presence or absence of slag inclusions. The material was a nickel-chrome alloy steel of a composition which had given great trouble when made by the open-hearth process. The invariable defect with open-hearth steel had been failure of tensile tests in samples cut across the width of the forging. Longitudinally-cut sections gave every satisfaction. The trouble had been found to be due to manganese-silicate inclusions. When the electric-steel forging had had the usual amount of forge work put upon it, transverse tensile tests gave the same excellent results as longitudinal tests. Micro-sections were examined, and none indicated slag inclusions. As an ultra-exacting test the forging was mounted on a heavy lathe, and after the necessary rough turning had been completed the finest possible cut was taken from end to end of the piece. It was known that the presence of the slightest slag inclusion would betray itself by a breaking of the fine turnings resulting from the minute cut that was being made. The only breaks in the turning were those voluntary ones necessary to disentangle the lathe parts, so it was reasonably concluded that well-made electric steel need not include slag particles. If an electric steel could be made once without slag inclusion, then the presence of such an inclusion must be debited against the furnace staff and not the furnace. With regard to the possibility of slag inclusions resulting from the restfulness of the steel in an electric furnace, was not the boot on the other foot? The way to keep sand or oil mixed with water was to agitate the mixture. At rest they would separate. This was undoubtedly what took place with the slag in molten electric steel; it rose to the surface, and the longer the steel was at rest the surer was the separation.

Viscosity of Electric Steel.

Slight amounts of certain elements had an exceedingly great effect on steel. It was interesting to note that as much as 0.5 per cent. of calcium, reduced from the lime of the slag, had been detected alloyed in electric steel. Might this have some effect on viscosity in certain cases? The most probable reason for the difference in viscosity between electric and converter steel at a given temperature was the presence of ferrous oxide in the converter steel. One could observe such an effect of oxygen in the bath of an electric furnace, and it had on occasions confounded the inexperienced melter. The fluidity of his bath might apparently be all that was desired, and the metal might apparently be ready for tapping; but a sample might show it to be not sufficiently killed. The melter thereupon added a deoxidant; took another sample which showed the steel to be now properly killed; called up the ladle; tapped the furnace; and then found to his dismay that the steel ran sluggishly. The explanation was that the fluidity test he made on the unkilled steel was entirely misleading, on account of the ferrous oxide which was present, causing the steel to be very fluid at its too low temperature. As soon as the steel was thoroughly deoxidised the lack of temperature became apparent.

DISCUSSION.

In the discussion which followed MR. EVANS, referring to the question of slag inclusion, suggested the measuring of the nozzle before it was put into the ladle and after.

MR. STOBIE replied that that was not a slag inclusion. It was a stopper end inclusion, which was extremely liquid when molten.

In reply to a question as to whether there was any difficulty in getting a falling slag, MR. STOBIE said that there was, but that one could have a non-falling slag and still have a proper steel. He did not know whether the questioner was thinking of alloy steels or plain carbon steels. In the case of plain carbon steel he could not recall any experience of it. He thought that with a plain carbon any lack of falling in the slag would be due to the presence of over-much silica in the slag.

High Heat and Burnt Steel.

MR. TENNANT, quoting the statement that "it was almost impossible to overheat or burn the steel," said that not long ago he had had some trouble with steel. It was re-annealed, and a micro-section was sent for analysis. The report was that the metal had been severely overheated in the presence of the arc before it left the furnace, and that there was nothing to be done but remelt. In regard to the quietness of samples of electric steel, he had another experience. The sample was almost set, and it had a good draw, but when it was struck with a hammer there was a great shower of sparks. That seemed to emphasise Mr. Stobie's statement that great care must be taken in the examination of samples before casting. Mr. Stobie had spoken of the improvement effected by raising the roof of an electric furnace. His firm had had the same trouble, and after they had raised the roof about three bricks they found a great economy in refractory. But after they put on economisers they found that they could lower the roof to the original position and still had economy.

Referring to fluidity Mr. Stobie had spoken of a metal that was full of life in sampling but that was dead immediately afterwards. He had had a similar experience. They had great difficulty in getting heat. No matter how long the power was turned on they could not get fluidity in light work. But he found that by altering the shape of the bath the trouble was removed. What was his opinion of that?

MR. STOBIE replied that he rather thought he would join issue with the metallurgist who reported about the burned steel. What were the micrographs like?

MR. TENNANT said that one of the micrographs showed an oxide inclusion, which the report put down to severe overheating.

MR. STOBIE replied that it was difficult to correlate the high heat with oxide inclusion. If it was a metallic oxide it would almost seem as if the steel had not been properly deoxidised. The very smallest amount of oxygen would have a considerable effect on steel. He once decided to use twelve 8-in. ingots to get a rough idea of the effect of oxygen in steel. He put a quantity of mill scale into the steel before tapping, and it was astounding to see how little mill scale made the material entirely different. He should say that there was less than 0.005 per cent. of iron oxide in these ingots, yet it seriously upset its general condition. Too high a casting temperature was bad, but he had never seen a bad result from a change of temperature during the actual making of the steel.

IT IS ANNOUNCED by Guest, Keen and Nettlefolds, Limited, that 114,794 5 per cent. (tax free) cumulative second preference shares of £1 have been issued as consideration for the acquisition of one or two small businesses, bringing the total amount issued of this class of capital to £4,629,964, out of an authorised £5,000,000.

Permanent Magnet Steel.

The two most popular grades of magnet steel are tungsten and chrome magnet, and, in a consideration of the type of steel which will make the best permanent magnet, there are factors other than that of magnetism which must be considered. For instance, the steel must be capable of being melted without any tendency for any of the constituents to separate out on freezing; the metal must be easily rolled so that the minimum of heating is necessary; the work to be done on the billet in rolling it to the finished size must be carried out so that the finishing temperature is of a pre-determined value; and the steel may not be so air-hardened that it is impossible to work it without annealing. Annealing chromium or tungsten steel reduces their magnetic values unless very great care is taken, and at the most only indifferent annealing can be done if the highest magnetic qualities are to be obtained.

The following points are also important:—(1) The steel must have a high hysteresis co-efficient to give the necessary retentivity; (2) it must be capable of being made extremely hard; (3) the microstructure must be very stable and not affected by slight temperature changes; (4) the magnet steel, when hardened and magnetised, must not be subject to undue secular changes; and (5) the steel must be absolutely homogeneous.

The principal magnetic properties in which the user of magnet steel is most interested are: First, the amount of magnetism that goes through the steel, which is usually indicated by maximum permeability at a given magnetising force. This given magnetising force is situated well beyond the so-called "knee" of the curve, that is to say, in the region where any further increase of field strength or magnetising force does not give any real increase in the magnetic induction.

After having ascertained the maximum amount of magnetism that will go through a bar of steel at a given magnetising force, the next point of interest is what is usually termed the residual induction, that is, how many of these lines will remain resident, or permanent, in the magnet steel after the magnetising force is reduced to zero.

Another point of interest is the coercive force, which indicates what strength of field must be induced to remove entirely all the lines of induction that are residual in the magnet steel. The coercive force is generally taken as an index of how permanent the residual magnetism will be. The larger the coercive force the more permanent the residual induction is supposed to be with time, and *vice versa*. By many skilled metallurgists the product of residual induction and coercive force is considered an excellent criterion of the strength of the magnet.

Tungsten magnet steel has usually better magnetic properties than chrome magnet steel, though the latter is easier to work and is lower in first cost. If sufficient weight of magnet is used, this more than offsets the extra magnetic value of the tungsten magnet steel.

Recent orders received by the Constructional Engineering Company, of Birmingham, for foundry plant include the following:—Brush Electrical Engineering Company, Loughborough, an 8-ton cupola, complete with electric telpher for charging, fan and motor; British Castings, Limited, Old Hill, a 3-ton cupola; Manchester Dry Docks Company, Ellesmere Port, a 3-ton cupola; Brookes (Oldbury), Limited, Oldbury, a 3-ton cupola, with fan and motor, etc.; Beyer, Peacock & Company, Manchester, cupola, fan and motor, etc.; Dudley Foundry Company, Brierley Hill, two complete melting units, consisting of two 6-ton cupolas, built to the "Poumay" system, fan and motor, etc. (this is the sixth repeat order for cupolas received from this firm); and Mather & Platt, Limited, Manchester, an experimental melting plant.

"Titanite," a pattern making material recently placed on the market, is rapidly coming into general use, and regular repeat orders are being received for increasing quantities from leading foundries throughout the country and abroad.

The Resistance to Wear of Cast Iron Containing Phosphorus.

It is well known that the phosphorus content has a distinct influence on the resistance to the wear of cast iron. Practical observations showed that the resistance increases with the increasing phosphorus content (up to 1.0 per cent. and more). Because of the greater reliability of cast iron high in phosphorus to fail under dynamic stress it is not desirable to exceed the percentage of 0.8 per cent. Recently E. Piwowarsky* caused some investigations to be made in this direction with cast iron the structure of which was almost pearlitic. Two types of machines were used for measuring the resistance to wear, the Spindel type and the Amsler type. The testing methods of the two machines may be briefly described as follows:—In the Spindel type the rectangular test sample is pressed against a rotating device (this was in the experiments in question a disc of sheet steel of 300 mm. diameter which made 25 r.p.m. The pressure was from 3 to 10 kg.). The resistance to wear is measured by the length of the chord of the circular incut. In the Amsler type the metal to be tested forms two rotating discs pressed to each other at their circumferences. The discs are 30 to 50 mm. in diameter and about 10 mm. in thickness. By adjusting the machine the kind of friction between the two discs can be changed from pure rolling friction to more complicated kinds. The resistance to wear is measured by the loss of weight of the samples. The discs rotate with about 200 r.p.m.; the pressure can be changed from 20 to 300 kg.

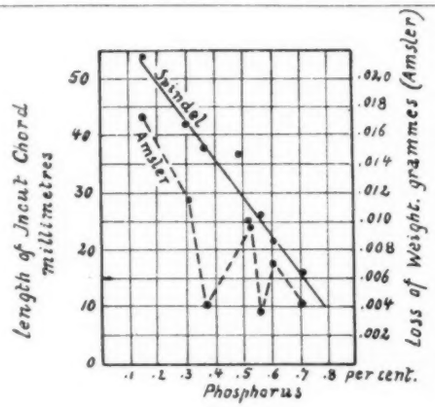


Fig. 1.

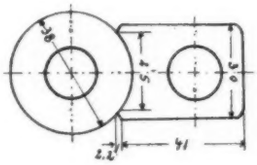


Fig. 2.

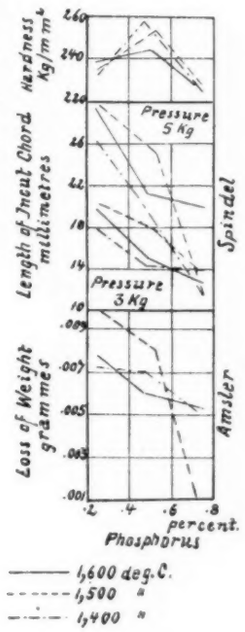


Fig. 3.

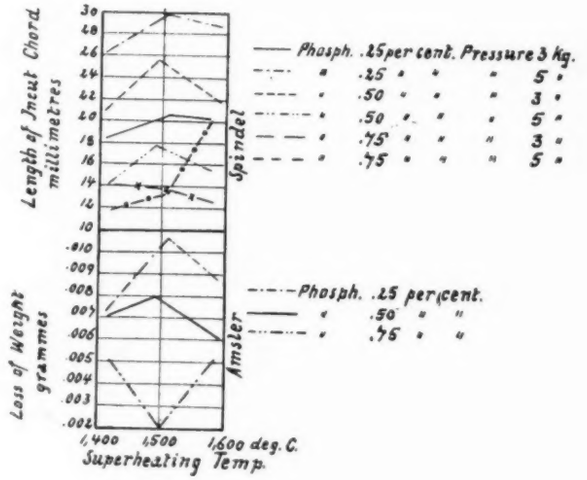


Fig. 4.

The compositions of the cast irons which were tested are given in Table I. The Nos. 1 and 6 represent samples made in ordinary practice. The other samples are laboratory melts made in an oil-fired crucible furnace.

TABLE I.

Sample No.	C. Per cent.	Mn. Per cent.	Si. Per cent.	P. Per cent.	S. Per cent.	Gr. Per cent.
1	3.12	0.92	2.00	0.068	0.090	2.42
2	3.17	0.74	0.88	0.30	0.023	1.43
3	3.12	0.77	1.23	0.35	0.028	2.47
4	3.17	0.75	1.10	0.51	0.027	1.77
5	3.10	0.68	1.01	0.55	0.028	2.47
6	3.20	0.61	2.04	0.58	0.124	2.70
6A						
7	3.15	0.86	0.43	0.70	0.021	0.52
7A						

Testing with the Spindel Machine.

The grinding disc consisted of sheet steel of 1 mm. of thickness with the following composition:—Carbon, 0.23 per cent.; silicon, 0.18 per cent.; manganese, 0.34 per cent.; phosphorus, 0.015 per cent.; sulphur, 0.032 per cent. The disc made 25 r.p.m. The pressure was 3, 5, and 10 kg. respectively. The time of testing was 10 minutes. The experiments were made without lubrication. Each sample was tested six times at the different pressures. Before starting a series of experiments the grinding disc was roughened by grinding a sample of mild steel. Because of the fine steel powder adhering to the grinding disc after this preparatory treatment the first two experiments of each series resulted in giving too high values (Nos. 1 and 2 in Table II), which were discarded in taking the average values. The length of the incut chords which are given in Table II and Fig. 1 can be compared with each other without making any corrections, as the diameter of the grinding disc had diminished by 3 mm. only after all the experiments. The loss of diameter of the grinding disc is given in Table III. From Table II it can be seen that the pressure of 3 kg. is too low to give any comparable results, whereas the pressure of 10 kg. is too high for some kinds of the cast irons used. The figures show that the testing method according to Spindel clearly indicates the great influence of the phosphorus content on the resistance to wear. This can be seen by comparing the results of the samples 2, 3, 4 and 5 respectively, which have nearly the same phosphorus content, but varying amounts of graphite. Sample No. 7, with the highest phosphorus content, shows the best values; here, however, the high carbide content might have helped in this direction.

Testing with the Amsler Machine.

The experiments were carried on with sliding friction. The counter disc was stationary and

TABLE III.

	Loss of the diameter in millimetres.								
	1.	2.	3.	4.	5.	6.	6a.	7.	7a.
Average value.	0.005	0.005	0.005	Pressure = 3 kg. 0.005	0.005	0.01	0.015	0.02	0.025
,,	0.07	0.095	0.13	Pressure = 5 kg. 0.055	0.06	0.04	0.03	0.03	0.03
,,	—	—	—	Pressure = 10 kg. —	—	0.33	0.315	0.08	0.08

* Die Giesserei, 1927, No. 43, pp. 743–7.

consisted of piston-ring cast iron. The pressure was 50 kg., and the time of testing 60 minutes. The samples were lubricated with cylinder oil. The test figures given in Table IV and Fig. 1, though somewhat divergent from each other, show the same tendency as those shown by the Spindel method.

TABLE IV.

Sample No.	Experimental disc.		Counter disc.	
	Hardness, kg/mm².	Loss of weight, grs.	Hardness, kg/mm².	Loss of weight, grs.
1	199	0.0172	192	0.0120
2	184	0.0117	194	0.0182
3	187	0.0041	197	0.0084
4	167	0.0100	191	0.0107
5	185	0.0032	196	0.0043
6	210	0.0070	199	0.0060
7	200	0.0090	184	0.0118
7A	201	0.0041	186	0.0105

The following experiments were made to examine the influence of the superheating temperature together with the phosphorus content on the resistance to wear. The melts, the compositions of which are given in Table V, were made in a coke-fired crucible furnace of the Baumann type, superheated to 1,400, 1,500 and 1,600 deg. C. respectively and poured into dry-sand moulds at 1,350 deg. C. The experimental conditions were the same as stated above, with the single exception that the counter device in the Amsler test was of the form seen in Fig. 2. The experimental results are given in the Tables VI (Spindel test) and VII (Amsler test), and in Fig. 3.

Here, too, the resistance to wear increases with the increasing phosphorus content. The influence of the superheating temperature may be seen from Fig. 4: four of the six Spindel curves show a distinct minimum of the resistance at 1,500 deg. C. With one exception, the lowest superheating temperature shows the best values. Compared with the influence of the phosphorus content, however, that of the superheating temperature

TABLE VII.

Series No.	Melt No.	Experimental disc.		Counter disc.	
		Hardness, kg/mm².	Loss of weight, grs.	Hardness, kg/mm².	Loss of grs. weight.
I	1	216	0.0071	203	0.0045
	2	227	0.0105	—	0.0050
	3	199	0.0081	—	0.0128
				—	
II	4	249	0.0070	—	0.0037
	5	242	0.0079	—	0.0020
	6	227	0.0060	—	0.0034
				—	
III	7	212	0.0051	—	0.0028
	8	199	0.0020	—	0.0060
	9	218	0.0052	—	0.0027

seems to be of minor importance. As may be seen from Fig. 3, a distinct relationship between the Brinell hardness and the resistance to wear cannot be stated; this fact shows that the Brinell test used in practice, especially in the case of cylinder cast iron, is not quite suitable for this purpose.

Bronze Melting Furnaces.

In answer to numerous inquiries we would point out that the reverberatory furnaces which were illustrated, and for which operating costs were given in Mr. Rowe's lecture on "Some Developments in Engineering Bronze Founding" (issue of December 15) are manufactured by Messrs. British Reverberatory Furnaces, Limited, of 82, Victoria Street, London, S.W.1, and all correspondence should be addressed direct to them.

THE DEATH took place last week, at Ulverston, of Mr. Stephen Hart Jackson, at the age of 92 years. He was a director of the Millom and Askham Hematite Iron Company, Limited, and head of the firm of S. Hart Jackson & Sons, solicitors, Ulverston and Barrow.

TABLE II.

Cut No.	Length of incut chord in millimetres.								
	1.	2.	3.	4.	5.	6.	6a.	7.	7a.
				Pressure = 3 kg.					
1	31.0	21.0	23.0	20.5	13.0	17.0	20.0	15.5	14.0
2	17.0	11.0	14.0	9.5	11.0	10.0	13.0	12.0	11.5
3	14.0	9.0	11.5	8.0	7.0	10.0	18.0(?)	13.0	12.0
4	13.5	8.0	11.0	7.5	7.0	7.0	13.0	11.5	11.5
5	12.0	8.0	10.0	7.0	7.0	6.5	12.0	12.0	11.5
6	12.0	12.0	9.0	—	7.0	6.5	11.0	11.0	—
Average value. 3–6	12.9	9.2	10.4	7.5	7.0	7.5	12.0	11.9	11.7
				Pressure = 5 kg.					
1	60.0	47.0	41.0	37.0	32.0	30.0	28.5	21.0	22.0
2	55.0	38.5	39.0	31.0	27.0	22.5	22.0	18.0	18.5
3	47.5	42.5	42.5	27.0	26.0	21.5	20.0	18.5	17.5
4	53.0	41.0	41.5	24.0	27.0	23.0	20.0	16.5	16.5
5	58.0	41.0	34.0	24.0	26.5	19.5	20.0	15.5	—
6	59.0	42.0	32.5	24.0	25.0	20.0	19.0	15.0	18.0
Average value. 3–6	54.5	41.8	37.8	25.0	26.1	21.0	19.7	16.3	17.3
				Pressure = 10 kg.					
1	—	—	—	79.0	—	63.0	66.0	28.0	31.5
2	—	—	—	90.0	—	60.0	65.0	27.5	28.0
3	—	—	—	89.0	—	59.5	65.5	28.5	30.0
4	—	—	—	100.0	—	60.0	65.0	27.5	26.0
5	—	—	—	—	—	59.0	63.0	22.5	26.0
6	—	—	—	—	—	59.0	66.0	22.5	19.0(?)
Average value. 3—6	—	—	—	—	—	59.4	64.9	25.2	27.3

TABLE V.

Series No.	Melt No.	Heated to deg. C.	Poured at deg. C.	P.	CC.	Gr.	Si.	Mn.	S.
I	1	1,410	1,350	0.24	0.92	2.08	1.25	0.98	0.061
	2	1,510	1,350	0.25	1.00	2.06	1.23	0.90	0.062
	3	1,580	1,350	0.24	1.13	2.03	1.28	0.97	0.052
			1,350						
II	4	1,410	1,350	0.47	0.95	1.98	1.25	1.02	0.046
	5	1,490	1,350	0.52	0.94	2.00	1.23	1.15	0.039
	6	1,590	1,350	0.49	1.09	1.88	1.27	1.00	0.050
III	7	1,415	1,350	0.77	0.73	2.40	1.21	0.92	0.044
	8	1,500	1,350	0.75	0.68	2.24	1.27	0.91	0.049
	9	1,580	1,350	0.77	0.74	2.42	1.16	0.89	0.044

TABLE VI.

Incut No.	Melt No.											
	1.	2a.	2b.	3.	4.	5.	6.	7.	8a.	8b.	9a.	9b.
					Pressure = 3 kg.							
1	22.0	24.0	30.0	23.5	22.0	18.0	23.0	18.0	17.0	18.0	23.0	23.5
2	19.0	22.0	22.0	21.0	18.0	16.0	17.0	15.0	15.0	19.0	17.0	17.0
3	19.0	21.5	21.0	20.0	15.0	17.0	14.0	14.0	12.0	16.0	15.0	14.5
4	19.0	21.0	21.0	20.5	15.0	18.0	16.5	14.0	13.0	16.0	15.0	11.0
5	17.0	21.0	19.5	20.5	13.0	19.0	15.0	14.0	12.5	12.0	15.0	10.5
6	17.0	21.0	20.0	20.0	14.0	16.5	15.0	11.5*	8.0*	10.0*	14.0	10.0
Average value. 3-6	18.0	21.1	20.4	20.2	14.2	17.6	15.1	14.0	12.5	14.7	14.0	11.5
					Pressure = 5 kg.							
1	44.5	48.0		45.5	26.0	31.0	26.0	19.5	19.0		27.0	
2	28.0	35.0		35.0	21.0	26.0	22.0	16.0	16.0		22.0	
3	27.5	29.0		29.0	20.0	28.0	22.0	12.5	14.0		20.0	
4	26.0	28.0		29.0	21.0	26.0	21.5	11.5	12.0		19.5	
5	26.0	28.0		29.0	20.5	24.5	21.0	11.0	12.0		20.0	
6	25.5	34.0		30.0	20.0	24.0	16.0*	11.0	13.5		20.0	
Average value. 3-6	26.2	29.7		29.2	20.4	25.6	21.5	11.5	12.9		19.9	
					Pressure = 10 kg.							
1	—	—	—	—	32.5	—	35.0	36.0	25.0	—	—	
2	—	—	—	—	33.0	—	29.5	18.0	18.5	—	—	
3	—	—	—	—	29.5	—	32.0	20.0	19.0	—	—	
4	—	—	—	—	28.5	—	31.0	20.0	17.0	—	—	
5	—	—	—	—	28.0	—	32.0	21.0	20.5	—	—	
6	—	—	—	—	25.0	—	31.5	17.0	19.0	—	—	
Average value. 3-6	—	—	—	—	27.7	—	31.6	19.5	18.9	—	—	

* These values were discarded.

Institute of British Foundrymen.

London Metallurgists Discuss Strip Casting.

After Mr. Newman's Paper, read before a joint meeting of the London Sections of the Institute of British Foundrymen and the Institute of Metals, on the subject of "Strip Casting,"* an interesting discussion took place. It was opened by the CHAIRMAN (Mr. A. H. Mundey), who said he had been particularly interested in Mr. Newman's address and was specially interested in the question of the oil dressing. He knew that one particular section insisted on lard, another on whale oil, and some on seal oil as the basis of the dressing. He could never quite understand why, because he felt that the temperature at which the metal is poured is undoubtedly above the flash point or the cracking point of any of these oils.

The Durville Process.

MR. WESLEY LAMBERT said that the casting of metal into iron moulds, as described by the author of the Paper, scarcely came within the practice of the British foundryman; this class of work was done by metal casters. During the war quite a number of firms were asked to cast strip ingots of copper-nickel. All those who have had experience of that metal know what a job it is to cast successfully such ingots. The casting of strip ingot is not an exact science, if it were, success would be more general. The casting of successful strip ingot is an art, and amongst those craftsmen engaged in casting strip ingot, some are more expert than others. It is quite true that to the casual observer no particular pains seem to be taken, and that the metal is simply poured into the moulds, and yet when one examines the ingots produced one had to admit that they had a very good appearance, and one began to wonder whether the secret was in the particular mould-dressing used.

In the Durville process the metal flowed into the moulds in a very gentle manner, a method which appealed to him because he could not perceive how it was possible to pour metal rapidly into an almost vertical mould, sometimes of considerable length, and to ensure uniform success with the absence of "shotting" and splashing; both of which happenings produced defective ingots. He favoured the Durville process, although personally he had not had an opportunity of trying it out in practice. Some years ago he had rigged up a somewhat crude piece of plant resembling the Durville machine, and had met with a certain amount of success. He did not gather whether the Durville method of casting had actually been put into operation at the Royal Mint. It seemed to be a very promising process, and he thought it might have a big future.

He was particularly interested in the question of segregation in ingot metal, of which mention had been made. Some metals, naturally, were more prone to segregation troubles than others. The most successful ingot, so far as freedom from segregation was concerned, was the one made under conditions conforming most closely to the known requirements of science. In other words, if one succeeded in getting a good cast in metals which were liable to segregation troubles, then wittingly or unwittingly, the best use of scientific principles had been employed.

Gases in Metals.

PROFESSOR TURNER said that some of them would remember the Paper by Mr. Cartland, who carried out experiments on the gases in brass. He extracted them and found that the quantity of gases was extremely small, in the order of something from about 5 per cent. of the volume of metal. Then they had had the gases extracted from steel, by Mr. W. Austin, and they found that they were of the order of five times the volume of the metal, so there was a very great difference. Then again Bamford and Ballard, working under his direction, carried out those experiments to which the lecturer had referred, finding that with brass it did not matter very much what the temperature or the atmosphere was; whether it was hydrogen, or carbon dioxide, or air, the results were alike and the quantity of gas absorbed by the brass was very small. Those who had experimented with other metals would have come to other conclusions, and the question was: How were they to reconcile the discrepancies? It might be illustrated by the gas in water. That was a typical liquid for the absorption of gas; no matter what the temperature was, it was found in nature to be practically saturated by gas under existing conditions. Freeze that water and it would give off gas, and if it were frozen quickly it would make opaque ice. On the contrary, if they raised the temperature of the water they would see bubbles of gas coming off. There was evidently a point of maximum solubility. With water when the temperature rose, they had an increased vapour pressure. It was a question of the partial pressure of the gas, as if they had an indefinite quantity of water vapour, that washed out the gas, and so the gas was given off. Now they had precisely the same conditions in brass. The experiments by Cartland and by Bamford and Ballard had to do with brass and not with metal which did not contain any volatile constituent. When they melted brass zinc vapour was given off, and for all practical purposes an indefinite quantity of zinc vapour was given off. That consequently washed out the other gases, and the result was that the quantity of gas which remained absorbed in the brass was extremely small. In copper, however, the quantity of gas dissolved increases as the temperature rises, or if the pressure increases the quantity of gas dissolved in the metal increases, and if they wanted sound castings, in that case they would have to take special precautions. One was the method adopted in the National Physical Laboratory, that of melting the metal and heating it above its melting point, allowing it to cool so as to give up the gases, cooling it off for a short time and then heating it up again. They were dependent first upon the character of the metal itself and the solubility of the gas in that metal and secondly on the volatility of the metal. When melting metals or alloys, there would be practically no effect from the atmosphere if a volatile constituent was present, because of the vapour pressure of the volatile constituent.

Influence of Casting Conditions on Subsequent Rolling.

DR. W. ROSENHAIN said that Mr. Newman's account of the strip casting process for coinage was interesting, and must have been even more interesting to those who were unacquainted with it. Yet it was interesting to him because it showed how thoroughly the various aspects of this strip casting problem had been considered. Mr. Wesley Lambert said that if one went into an ordinary foundry and saw strip casting in progress one would think that there was not very much in it. But when one studied the returns from those strip castings one would realise that there was a great deal in it if it were to be done as it ought to be done. In other ways the ordinary brass strip presented special problems. It had to be produced in longer lengths than the twenty-four inch casting used at the Mint, and in casting a long strip there was great difficulty in controlling the flow of the metal into the mould and maintaining a good, undamaged surface. To show the great effect of the method of casting, he wished to refer to the picture of the old casting machine which Mr. Newman had taken from a Report published in 1921. The object of that machine was to provide a specific path for the inflowing metal so that there should be no splashing and the mould would be steadily filled. Using that machine and varying the conditions of casting, it was possible to produce slabs of widely varying quality according to the temperature of the mould and rate of pouring, and it had been found that the behaviour of the slabs on subsequent rolling was also extraordinarily different. It was, in fact, possible to predict how those various slabs would behave. On one occasion a demonstration was given to a number of visitors in which a certain number of slabs were taken out of the same furnace, and it was predicted that certain ones which had been cast in a particular way would roll perfectly and that others would split, and every slab behaved as predicted, which showed that the behaviour of a cast body when rolled can be largely influenced by the mode of solidification. In the case he mentioned it was a matter of the size of the chill-crystals growing out from the sides of the mould and whether these crystals met in the middle or not.

There was just one point where some of the considerations Mr. Newman mentioned were not quite everything to be considered. He referred to the thickness of the mould walls. The heat capacity of the mould in relation to the heat capacity of the metal was of vital importance in determining the mode of solidification. Satisfactory results with certain alloys were only obtained if the weight of the mould was about three times the weight of the casting. That ratio might not apply to all metals, but in the particular case he mentioned it was an excellent guide which they found applicable to castings ranging from a tiny die casting of a quarter of an inch thick up to a three-inch ingot. Then came the difficulty of the material of the mould. Cast iron was used in most cases, and it had one very serious disadvantage, that was its porosity. Whatever dressing was used, if the iron was of an open grain, the dressing would not overcome it.

The Mint problem was a special one, because machining of the surfaces was not feasible, partly because of the loss of metal in the process. Machining should not be necessary, because it was possible to cast bars with a good surface. The most serious difficulties were the uniformity of composition, and the perfection of the surface. The countervailing advantages were that the alloy used could be freed from gases easily and the use of a comparatively small size of mould. When it came to the study of larger and longer ingots the problem was a very different one, and when Mr. Newman had an opportunity of casting metals of a more difficult kind into long strip moulds he would find himself faced with a large number of new problems. He (Dr. Rosenhain) was convinced, from the way in which Mr. Newman had dealt with his subject that night, that those difficulties would also be overcome in an equally efficient manner.

Casting Silver Ingots.

MR. G. C. PIERCE said he had been recently dealing with the casting of precious metals in the shape of standard silver. His difficulty was to get it into ingot form yet suitable to be drawn into very fine wire. Five hundred ounces of pure silver made something like five miles of wire, or, in other words, it had to be drawn down to two-thousandths of an inch diameter. He did not know which method of working required the more perfect condition of metal, that of drawing or rolling, but it did seem to him to be necessary for the metal to be as near perfect as possible for it to be drawn down to such a diameter. Some of his colleagues of the Institute of Foundrymen would remember that he worried them one night to give him a suitable dressing for a cast-iron mould, which he wanted to use for silver. He tried every kind of oil, and eventually he went to Boots the chemists and got some castor oil. That might surprise some, but actually it proved highly successful. He had also made a couple of cupro-nickel ingots in the same mould with the same dressing. The lecture to him was also interesting because much had been said relative to methods of pouring. The cast-iron ingot mould he was using was carrying something like 2.5 per cent. of silicon associated with fairly high phosphorus. He always cast absolutely vertically, and as the work was 3 ft. long and 1¾ in. diameter, he was a little surprised to think that he had been successful when he had heard so much about the only successful method of pouring. It was only in his first two or three attempts to get those bars did he have any trouble, and he put that down mainly to the dressing of the mould and the

* See the last issue of the Journal, page 3.

method of melting the metal. He found it necessary carefully to protect the metal and also to take a good amount of care in the application of the dressing of the mould. He was, however, perfectly successful so far as he had gone with the bars he made, and apparently he had overcome the matter fairly well without any of the intensely scientific applications such as were employed at the Mint.

Quiet or Still Casting Conditions.

MR. F. KAYSER (Sheffield) said that mention had been made about the disturbance of the mould while the metal was solidifying, which was detrimental. On what did Mr. Newman base that statement, because he distinctly remembered on several occasions having seen reference to moulds being agitated? Then there was the statement about the pouring down the side of the mould. They must remember that they would come to a point when that system was quite impossible, that was when the metal had a high melting point. Steel, for instance, must not be poured down the side of the mould, otherwise it would be frozen. He pointed out that it was quite easy to pour down a mould, only an inch wide, without touching the side if a tundish was used. He would like to classify strips into two classes, those required to be hot rolled and those required to be cold rolled.

Furnace Efficiency.

MR. H. C. DEWS pointed out that he had had to deal with the problem of casting in chills bars 9 ft. long, varying in diameter from ½ to 1¾ in. That was quite a difficult proposition, and he found the only way was to cast with the mould perfectly vertical. The metal must not run down the sides of the mould, and, in view of that, he was rather surprised to find that the Durville principle and other similar processes had had such success. With regard to the material for moulds for chill casting, here again they were up against the same sort of difficulty they met with in almost every scientific discussion, and that was that they did not know anything about cast iron. If they studied the literature on the subject they would find an enormous diversity of opinion. There were two schools, one which favoured high phosphorus and the other which favoured low phosphorus. Personally, he found in those experiments that the mould which gave the best results was the one made approximately of the same composition as the one Mr. Newman mentioned as used by the authorities at Woolwich. He favoured a fairly low silicon, high manganese and phosphorus about 0.2 per cent. Those moulds were giving very satisfactory service.

As regards the dressing, he was in agreement with what had been said. They could never go into two foundries doing the same work and find that they were using the same mould dressing. There seemed to be a need for a very close scientific investigation into the requirements for a good dressing. He did not mean that the flash point or that the commonly accepted properties of the oil had much to do with the particular problem. Mr. Newman's notes on melting were particularly interesting. The pre-heating was somewhat novel, although similar schemes had been attempted in one or two cases, but it was the first time he had heard of that particular system mentioned by Mr. Newman, and it semed to be a valuable hint. Then he wished to mention that the thermal efficiency of a pit-type coke-fired crucible furnace was something like 3 per cent., which made one wonder where all the heat went. He put a pyrometer in the flue of an ordinary coke-fired bronze hole, and the temperature was between 400 and 300 deg. C., so that in that case he was rather wondering whether that system of pre-heating was going to raise the thermal efficiency very much.

Apparently Similar Casting Conditions Differentiated.

MR. BAILEY said mention had been made of the effect of the stream on the walls of moulds, and doubts had been expressed about the Durville process on those grounds. He pointed out, however, the disadvantage of a small stream of metal impinging steadily on the walls of the furnace, and the advantage of the Durville process in which the stream flows in extremely gently. There was no continual impinging on one spot of the wall of a stream of metal.

Author's Reply.

MR. NEWMAN, in his reply, said with regard to the mould disturbance, that they at the Mint had found that the shifting of the mould carriage as each mould was filled had materially influenced the physical properties of the bars of certain alloys cast in these moulds. It was a fact that vibration of the mould had been tried as a positive measure and found to be successful, but, no doubt, particular conditions were required for particular alloys. In regard to the pouring down the sides, of course, in strip casting they did try to pour centrally into the moulds, and they did adopt the method which had been suggested that night by Mr. Kayser of using a crucible with a slit in the bottom in order to direct the stream through the centre of the mould. The strip casting he had mentioned was the method they used for strips to be rolled cold. The closing up of cavities could only occur if the strips of ingots were made hot before rolling. Mr. Dews referred to the temperature of the gases and in an ordinary coke fire flue the temperature would be about the temperature he mentioned, about three hundred or four hundred degrees. In one particularly bad set of furnaces they found that the temperature went up considerably, and that was the experience which led them to try the pre-heating methods in order to endeavour to use up some of the heat which otherwise would be lost.

Vote of Thanks.

MR. FAULKNER said the present meeting was always looked forward to with particular pleasure by the members of the Institute of British Foundrymen. This was the sixth year they had had the joint gathering, and each year it had become larger and more interesting. The lecture had been one which had a definite appeal to foundrymen, and even the most practical man could not complain that the lecturer had been speaking above his head. If he might digress, he wished to say how much he appreciated Dr. Rosenhain's remarks on the ingot moulds, and he wished to draw their attention to the thin plate at the back of the ordinary kitchen fire grate which was heated and allowed to cool three hundred and sixty-five days of the year, and did not suffer from the evil effect of growth. It seemed that the influence of mass was more important than the oxidation of the silicon content. On behalf of the Institute of Metals and the Institute of British Foundrymen he proposed that a hearty vote of thanks be accorded the lecturer.

The CHAIRMAN stated that it was his duty, as chairman of the Local Section of the Institute of Metals, to second the vote of thanks, which he did with great pleasure. He knew that Mr. Newman had the gift of putting before the practical man and before the scientific man matters which were of so great an interest in an intelligible manner so that they were instructive to both sides of the house.

Many Women Metallurgists.

He also wished to mention that they were very proud indeed at having heard of Dr. Elam, who was a member of the Institute of Metals, and a friend of many of them, who had been promoted to a big job in South Africa. They were very proud of it, indeed, but he did wish to protest against the statements in the daily Press that she was the only woman metallurgist. They had that distinguished woman, Dr. Marie Gayler, who had done wonderful work under Dr. Rosenhain. They had others; there was Mrs. Shaw Scott, Miss Kathleen Bingham, Mrs. Hanson, Miss Grace Ford, and several others. He mentioned those named without taking the slightest credit from Miss Elam.

Mr. Newman was accorded a hearty vote of thanks, and the meeting then terminated.

Dry Gasholders, Limited, 39, Victoria Street, S.W.1.—Capital £5,000 in £1 shares. Directors: S. Cutler, R. J. Milbourne, W. Beswick, and T. V. Miles.

Random Shots.

It is interesting to note the strange and unexpected causes that lead to new or extended uses of a material. I was reading recently of the reconstruction of the Lens coal mine area, which, like other parts of Northern France, was reduced to a condition which my authority describes as a "dust-heap." One of the greatest problems of reconstruction was not so much to undo the damage that had been done, as to find the materials wherewith to repair it, the roads, for instance, being practically non-existent for miles around. And since there was clearly no timber at all within reach, and the expenses of transport were enormous, we are told that "iron bars" have been largely used in place of wood to support the galleries. This is a particularly interesting fact in view of the attention that is at present being given in this country to the possibilities of steel for pit props.

* * * *

Discussion of the problems of hire-purchase, and the spheres in which this method of doing business is especially popular, recalls the rather unexpected and interesting fact that when coke ovens were first introduced into this country from abroad they were sold on this very system, their popularity being greatly stimulated thereby. Financial accommodation more or less closely approximating to this method is not unsual in the industrial world after all, but on the whole it is connected in the public mind rather with furniture and motor-cars and synthetic jewellery than with anything so altogether permanent and considerable as a coke oven.

* * * *

No founder, and no one who has any interest in the iron industry of this country, can fail to be interested in the Diamond Jubilee Number of our respected contemporary—we might almost say our elder brother—THE IRON AND COAL TRADES REVIEW. The issue is, to begin with, stupendous in bulk and weight, but that is not all. Its contents afford in fact a most remarkable summary of sixty years' development at home and abroad, and since the sixty years just ended have been of extraordinary interest and importance in all matters pertaining to iron, steel and coal, there is no lack of material. Indeed, if one's first feeling is of respect and admiration for the scale of the enterprise, one's second sentiment is something like despair as to where to begin. Text, tables, diagrams, maps, and photographic illustrations are so varied and so extensive. It is on occasions like this that one falls back on the childish but not ineffective method of opening at random—or, if you want to do the thing thoroughly, you may insert a hat-pin, knitting-needle, or table-knife!

* * * *

It is just about this time of year that the annual problem of the calendar assumes its full importance. No, I am not under any misconception as to the date, and I am fully aware that January is half gone. After you have dated all your cheques and letters "1927" for a fortnight, you begin by getting rid of the old calendar-stumps and out-dated diaries. You then relegate the more grossly propagandist of your Christmas offerings to the waste-paper basket. You select the only business-like specimen for office use, and the next least offensive for your desk or study table at home You allot to the sitting-room the fairly harmless contribution from a near and dear friend of susceptible mind whose visits are frequent and unexpected, and you adorn the spare room with the peculiarly inartistic but mightily expensive one emanating from a wealthy aunt whose ill-humour dare not be risked.

* * * *

And probably there are still half-a-dozen unplaceables left, besides the six or seven diaries and memo-pads you have presented to your wife for her household accounts. No, the old-fashioned Christmas cards had their points; at least, you could throw them away without any qualms if your taste did not happen to match with that of the sender.

MARKSMAN.

North-East Coast Foundrymen Visit Blast-Furnace Plant.

On December 10 about 80 members of the Newcastle Section of the Institute of British Foundrymen visited Messrs. Palmer's Shipbuilding and Iron Company, Limited, Jarrow, by invitation of the Company. The party was received by Mr. Thursfield, the blast-furnace manager, and Mr. Wilson, who personally conducted the party, the power house being first inspected. The blast furnaces were next visited, there being five of modern design, with the usual equipment of hot-blast stoves. As a general rule these furnaces are worked three at a time, each furnace being blown from a separate main, which can be alternatively coupled to any of the four blowing engines.

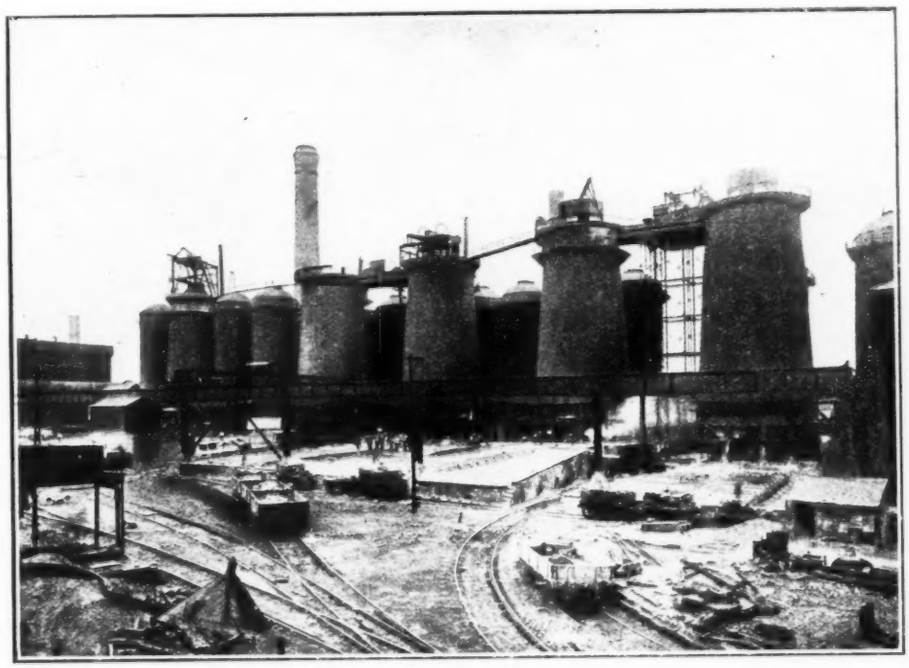


FIG. 1.—THE BLAST-FURNACE PLANT AT PALMER'S IRON AND STEEL COMPANY, LIMITED, JARROW.

The furnaces are all about 80 ft. high, with hearths varying from 11 ft. 6 in. to 13 ft. in diameter, and are so arranged that the product can either be delivered in a molten state to the steel works for the manufacture of steel, or cast into "pigs" for delivery to the engine works and foundries of the Company, or, as is the case with a large proportion of the output, delivered to customers over the whole of this country and abroad.

The iron cast as pigs (pig-iron) is lifted from the beds in combs by overhead electric cranes and delivered to an electrically-driven machine which automatically breaks up and loads the pig-iron into trucks.

The blast furnaces are in direct connection with various railway systems and closely adjacent to the Company's own deep-water wharf on the river, at which the steamers bringing the ore from Spain and North Africa, or, alternatively, smaller vessels bringing ore from the Company's own mines in this country, are berthed, and this position permits of all the necessary raw materials, the several classes of production, and the waste products being handled with a minimum of cost and effort.

The party next visited the foundry, where they saw cylinders being moulded and rammed, and the machine shop. The metal foundry is an extensive brick building consisting of two main bays. Projecting from these on three sides are the core-drying stoves, which are equipped with the "Priest" patent saturated fan blast firing system. On the west of the main bays is the cleaning shed.

The brass foundry is a steel structure consisting of one large main bay, with two smaller side bays running the full length of the main bay. The core stoves here are also fitted with the "Priest" system.

These foundries are fitted with the latest equipment, including electric cranes, portable mould dryers, with electric fans, and sand-jolting machines, etc. They can deal in most modern fashion with all the castings required by the various departments of the firm. In addition to ordinary marine castings for reciprocating engines, turbines, gear cases and marine oil engines, a very large business is done in the production of ingot moulds and slag tubs.

After being shown over the works, the visitors were entertained at tea by the Company. Mr. C. Gresty said he was sure he was voicing the feelings of all members present when he asked Mr. Thursfield to convey their hearty thanks to the directors of Messrs. Palmers for giving them that opportunity of seeing round the works, and also for their hospitable reception. Their thanks were due also to Mr. Thursfield, Mr. Wilson and other members of the staff who had devoted the afternoon to making the visit so successful.

In reply, Mr. Thursfield said it had been a pleasure to show them round the works. He pointed out that in building ships, the Company were able to start from the actual iron ore, which went through the various processes necessary to convert it into the plates and castings finally used in the ships. Unfortunately, there had not been time for the visitors to see all these processes, but he hoped that what they had seen had proved interesting. On behalf of the Company he extended a cordial welcome to the members.

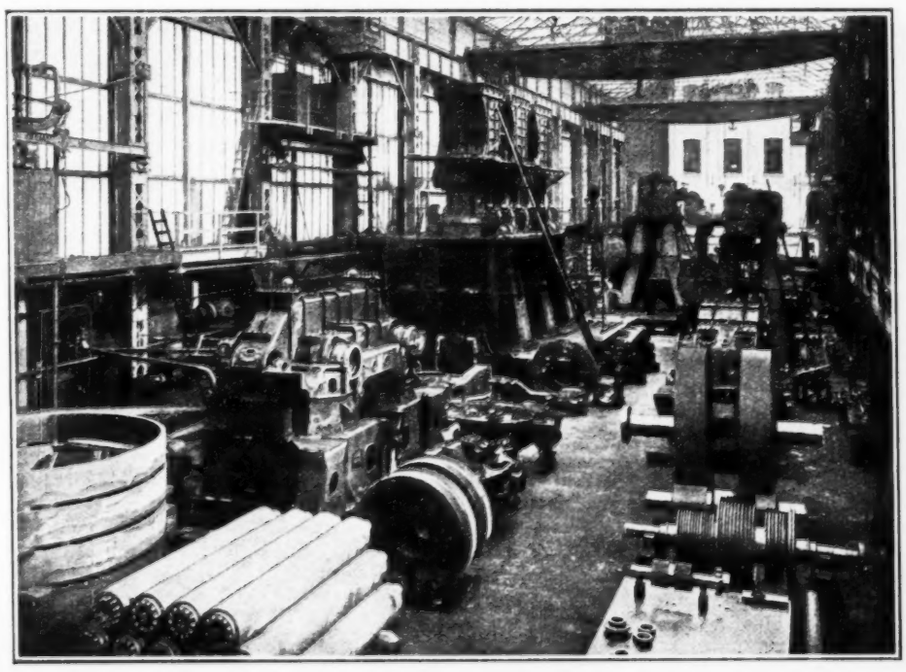


FIG. 2.—THE ERECTING SHOP, PALMER'S IRON AND STEEL COMPANY, LIMITED, JARROW.

Large Electric Furnaces.

The chief difficulty encountered in the manufacture of ferro-alloys and carbide in electric furnaces is the cost of manufacture owing to the large consumption of electricity, with the result that metallurgists in this country and abroad have been for some time conducting investigations into the design of these furnaces with the view of decreasing the amount of energy required. One direction in which economy is possible is in the reduction of the number of electrodes, and news comes from France that one of the leading metallurgical firms in that country has been successful in designing a single electrode furnace of high efficiency. The electrode in this furnace is 7 ft. 6 in. in diameter and 4 ft. high. The furnace itself is made of ferro-concrete and is sheathed with lead, and is cooled by means of water coils. This furnace has been put into use for the manufacture of ferro-silicon, ferro-manganese and carbide, the voltage required being from 40 to 60 for these various products. The average consumption of energy per ton of carbide or ferro-alloy is 3,250 KWH, and the furnace will withstand a current of over 100,000 amperes.

Modern Refined Irons.

By J. E. HURST.

The term "refined iron" has been familiar in the iron trade for many years, but in spite of this there has always been some uncertainty as to its exact meaning and the character of the product which it was intended to define. This uncertainty arises entirely from the loose and indiscriminate use of this term, even from its earliest inception, which appears to date back to the middle of the XVIII Century, after the development of blast furnace processes of smelting iron ores had reached the stage of cast iron or pig-iron production. At this period malleable or wrought iron and steel were produced from blast furnace pig-iron by its treatment in shallow hearth type furnaces. In this treatment the carburised pig-iron containing silicon and other impurities was purified or refined, the carbon and other impurities being oxidised and removed partially by the aid of the strong air blast, and partially by the slag rich in iron oxide content. The hearth furnaces in which this operation was performed were known as "Bloomeries," a word which has been etymologically connected with the Saxon word "Bloma," meaning a lump, and referring to the lump or bloom of iron resulting from the operation. As in the case of the later puddling processes the iron or steel resulting from this operation was squeezed into the required shape and freed from intermingled slag by forging under the hammer.

Early History.

It is very probable that the term refined iron was originally applied to the malleable or wrought iron and steel products produced in this manner, although this appears to be uncertain, and all these terms, viz., refined, malleable, wrought, etc., appear to have been used indiscriminately about this time. The term refined iron commences to assume a more definite meaning about the beginning of the XIX Century. In the bloomery or shallow hearth type of furnace it was found that white pig-irons were more suitable for conversion into malleable irons, owing to their becoming pasty, in which condition they could be thoroughly incorporated with the slags rich in iron oxide. In order to utilise grey pig-iron a sort of initial treatment was developed in which they were converted into white irons. This process was carried out in a hearth type of furnace, with deeper walls, which was known in this country as the "finery," and the operation was definitely referred to as refining. In Germany the process was referred to as "weiss-machen," or whitening, a term which has the merit of more definitely defining the operation. The finery consisted of a rectangular hearth about 3 ft. wide, 2 ft. long and 2¼ ft. deep. Above this hearth a chimney, about 18 ft. high, was usually erected. The hearth was formed of water-cooled iron blocks, and a number of tuyeres inclined downwards towards the hearth at an angle of 25 to 30 deg. were provided. The hearth was filled with coke and layers of iron and coke subsequently charged. Under the action of the blast, on the incandescent coke, the metal was melted, and was subjected to the continued action of the blast in the bottom of the hearth for a sufficient length of time according to the extent it was desired to refine it. The refined metal was tapped out into a shallow cast-iron mould in the form of a plate about 10 ft. long, 3 ft. wide and 2 ins. thick. This refined metal, or plate metal as it was sometimes called, was broken up into small pieces for further conversion into malleable iron or steel. In this case it is evident that the term refined iron was applied to the production of the finery, and was grey pig-iron converted into white pig-iron for subsequent use in the production of malleable or wrought iron. This refined product was simply an intermediate stage between grey pig-iron and malleable or wrought iron, and by slight modifications in the treatment malleable iron was produced direct in the finery. In various districts the finery process was operated to produce what we might term the refined intermediate product, white pig-iron, malleable iron or steel at will, and it is from this fact that the indefinite nature of the term refined iron arose.

Patent Classification.

In the Patent Office classification the term refined iron is loosely used to cover the product of refinery furnaces, whether pig-iron, malleable iron or steel. One of the earliest recorded patents in this classification is that of David Mushet, dated 1815, in which an attempt was made to carry out the refining process direct in the blast furnace. In this patent it is distinctly stated that the refining process may be used for the production of either malleable or cast iron. A much later patent dated 1866, by Benjamin Bayliss, covers the design of a puddling furnace with three chambers. In the first the iron is melted, and afterwards run into the "second or fining chamber." In this chamber the metal is "fined" by jets of air injected into it. The fined iron is run into the third or puddling chamber in which it is converted into malleable or wrought iron.

There can be no doubt from a study of the early patent specifications that the term refined iron was more extensively used to indicate the more or less purified and specially prepared pig-iron for use in converting to malleable or wrought iron and steel. The term cannot be considered to have any connection with the character of the fuel used whether coke or charcoal, as both these fuels were used in the early refineries. In a like manner it can have no connection with the blast temperature. Whilst in the early days the fineries were operated with cold blast, the furnaces were later designed to utilise the heat in the waste gases for heating the pig-iron required for the next charge and for preheating the blast.

The gradual displacement of the early methods of malleable iron and steel production, firstly by the puddling processes and later by the Bessemer and crucible and open-hearth steel-making processes, resulted in the abandonment of the manufacture of refined irons for these purposes. In modern times refined pig-irons still continue to be produced for use in the production of malleable castings. The early practice in ironfoundries of remelting pig-iron once or twice before using it for castings, a procedure demanded in the early specifications for high-grade castings, became known as refining and the product was frequently spoken of as refined pig-iron.

Modern Refined Pig-Irons.

On the grounds of both history and tradition the brief consideration above is sufficient to justify the application of the term refined irons to pig-iron as distinct from malleable wrought iron or steel. In the abstract the idea of refining, as applied to pig-iron, may refer to any treatment to which blast-furnace pig-iron is subjected to make it more suitable for a particular operation. The actual character of the refining operation may consist of the removal of some or several objectionable constituents, or it may consist of the admixture of other desirable constituents or special treatments, depending entirely on the nature of the particular purpose for which the iron is intended. To-day the situation is characterised by a different outlook, and the influence of the composition, condition and treatment of iron are better understood from the point of view of their influence on the character of the final product manufactured. Under these circumstances there exists on the one hand a demand for supplies of irons having certain well-defined properties and characteristics for different purposes, and on the other hand irons are produced fundamentally from blast-furnace pig-irons by re-treating them in various ways to satisfy these requirements. These special irons constitute the classification of modern refined pig-irons, which may be defined as those pig-irons prepared by re-treating blast-furnace pig-irons with the object of improving their properties, qualities and characteristics for given special requirements.

UNDER THE TITLE of Davum Exportation a Belgian Company has been formed for the sale as from January 1, 1928, of the iron and steel products made by the following concerns :—Compagnie des Forges et Aciéries de la Marine et d'Homécourt, Société des Hauts-Fourneaux et Aciéries de Differdange-St-Ingbert-Rumelange (Hadir), Société Lorraine des Aciéries de Rombas and Société des Aciéries de Dilling The Company's registered offices are at 25, Quai Jordaens, Antwerp.

Handling Patterns.

By J. M.

Some years ago, in a certain large jobbing foundry with which the writer was connected, the moulders were placing a big marine bedplate into a pit, when the bearings tore away from the side members. The pattern was rather badly damaged, and it was a difficult job getting the various parts together in the pit, and ensuring that they were accurately located. A discussion arose as to whether pattern shop or foundry was to blame for the mishap, but it was undoubtedly the pattern shop's fault in not properly securing the heavy parts to each other. It may be said, however, that foundries are not always as gentle as they might be in slinging patterns, especially when there has not been a careful previous examination.

No matter how carefully a heavy pattern is made, or whether screws or bolts are employed to hold the various parts together in conjunction with suitable strong battens, if it is not slung carefully on to a lorry or wagon, and likewise carefully handled at the foundry, it will get "out of truth." It is always advisable to take the most extreme precaution in joining up parts that will be separated in the mould, even if a little more time is involved in both pattern shop and foundry. There is also a knack in slinging; with castings, care is taken to equalise the strain on ropes or chains, and, in the pattern shop, similar care has to be exercised, but for rather a different reason. The pattern may be well within the safe lifting weight of the slings, but if they are not very carefully adjusted so that all take the strain simultaneously, the pattern may be badly twisted. True, if it is laid on a level bed in the foundry it may resume its correct shape, but it is not safe to rely upon this.

In small pattern shops the usual method of getting a heavy pattern on to a lorry is for all the men to get round it and lift it on. Often in large pattern shops also this is done, but in a few shops there is sufficient room for a lorry to enter, and the pattern is conveyed to it by an overhead runway. It is probably because it is used comparatively seldom that the overhead crane or runway is not often installed, but it is usually profitable to have one. When pattern shops are on an upper floor, work is sometimes severely knocked about in being lowered to the ground.

In a railway wagon, or a lorry, there is scope for some skill in inserting packing pieces. We have seen patterns start on a long journey in good condition, but, when they reached the foundry, parts were broken off. Unless a large pattern completely fills a wagon, it is always advisable to insert plenty of wedges, packing pieces, and battens to prevent it from moving during the journey. There is then no excuse if the foundry injures it in transporting it to the floor.

At the foundry it is as well if a patternmaker is in attendance on the arrival of patterns. He not only loosens off temporary stays, but, and especially is this true if he is accustomed to the class of work, he quickly detects weak parts of the patterns that have to be supported.

In sending small patterns by rail, practice varies. We have known of sawdust being used, which is rather ridiculous, and the use of shavings is common. A large number of small patterns will be made up in one crate or packing, and the shavings have to be sifted at the foundry. Shavings are sometimes used for fairly large patterns. We prefer the method, whenever possible, of packing small patterns tightly together without shavings, as there is less likelihood of any of them getting lost. In may be quicker to use shavings, but there is always a possibility of a pattern being lost. The foundry seldom troubles about shavings when returning the patterns.

THE IMPORTS OF foreign iron ore at the Senhouse Dock at Maryport during the last twelve months amounted to 60,950 tons, against 66,700 tons for the previous year and 106,450 tons for 1925.

An Oil-Fired Reverberatory Furnace for Melting Light Alloys.

Non-ferrous foundrymen have not, generally speaking, devoted great attention to melting costs, probably because a mistake in the buying of the metals constituting the charge can wipe out any economy effected by the installation of modern plant. Nevertheless, the more important concerns have assumed that their competitors can and do buy as cheaply, as they themselves are looking to a reduction of manufacturing costs to give them an advantage in their selling price. In the light alloy section of the industry the crucible pot is still largely employed. It may be of iron or graphite, and may use coke, town's gas or oil as fuel. The Shell Mex concern have investigated the costs of melting an aluminium alloy when using oil fuel, and their results are given in Table I.

Although these can be considered reasonably satisfactory, they do not show sufficiently overwhelming advantages against coke to make the use of oil-fired crucible pots for aluminium universal, and, in fact, they are more often than not operated with solid fuel.

Reverberatory Furnace.

In a Midlands installation, and in order to make the best use of oil firing, it was decided to employ the low air-pressure system, and at the same time introduce a simple form of recuperator so as to obtain a reasonably high efficiency. The furnace tested was a 6 cwt. tilter, supplied by the British Reverberatory Furnace Company, of 82, Victoria Street, London, S.W.1. Owing to difficulties, both in construction and in respect to the burner itself, the recuperator was designed as a very simple type, consisting merely of some tubes from the atomising air pipe being led through the flue extension of the furnace. The designers calculated to obtain a temperature of the atomising air amounting to approximately 250 deg. F. (120 deg. C.), and this was actually obtained.

The application of oil firing was carried out by firing almost directly over the metal bath, thus eliminating the fairly large solid fuel fire-box which exists in other types of this furnace. The final arrangement, as will be seen from Fig. 1, forms quite a simple and easily operated furnace, and offers the advantage with oil in so far as the tilting, when pouring the molten metal, is not handicapped by a bed of solid fuel.

The "Rotamiser" burner was chosen as it has the reputation of giving particularly good atomisation, and hence a good flame temperature. It was feared, however, that the rotary portion of this burner would give trouble, particularly taking into account the fact that the air was preheated and the possible effects on the ball bearings. A small amount of trouble was experienced, but this was traced to poor grease, which was quickly rectified.

Aluminium was melted in this furnace with an oil consumption averaging between 6.4 and 6.6 lbs. of oil per 100 lbs. of metal, which compares with a much higher figure of 9 to 10 lbs. of oil per 100 lbs. of metal with crucibles. In addition, the time for melting down a charge of approximately 6 cwt. is well under half-an-hour. When one compares this time figure with the 1½ hours taken on a 3 cwt. crucible furnace it will readily be seen what a distinct advantage this furnace gives with respect to rapidity of output.

During the official tests the maximum number of charges melted down was only seven, but later reports indicate that the furnace is now being operated to give 13 charges of metal of 6 cwt. each per working day.

The elimination of the crucibles themselves forms by far the greatest saving in the direct cost. It has been stated that these pots last an average of 60 to 70 melts each of 3 cwt., but this is rather an optimistic figure and most pots only last about 40 melts. The effects of aluminium on plumbago crucibles are distinctly violent since this metal has a strong destructive action on the material. The pots cost about £6 each, so that if taking even 60 melts of 3 cwt. each for the life of the pot, the cost per 100 lbs. of metal in crucibles alone works out to 7.1d., or approximately double the total cost of the fuel.

TABLE I.—*Cost of Working Oil-Fired Crucible Furnaces.*

Type of furnace	Crucible tilting.	Pot type tilter.
Capacity	400 lbs.	500 lbs.
Type of metal melted	Aluminium scrap.	Ingots and scrap.
Weight of metal melted	160 lbs.	500 lbs.
Amount of fuel used	26 lbs. per hour.	47.5 lbs. per hour.
Time of melt: 1st heat	75 mins.	75 mins.
,, ,, 2nd heat	40 mins.	60 mins.
,, ,, 3rd heat	35 mins.	—
Fuel used per 100 lbs. metal { 1st heat	20.3 lbs.	11.87 lbs.
Fuel used per 100 lbs. metal { 2nd heat	10.83 lbs.	9.5 lbs.
Air pressure	½ lb. per sq. in.	1 lb. per sq. in.
Loss of metal	1 per cent.	¾ per cent.
Cost of oil per 100 lbs. metal melted (2nd heat)	4.8d.	4.3d.

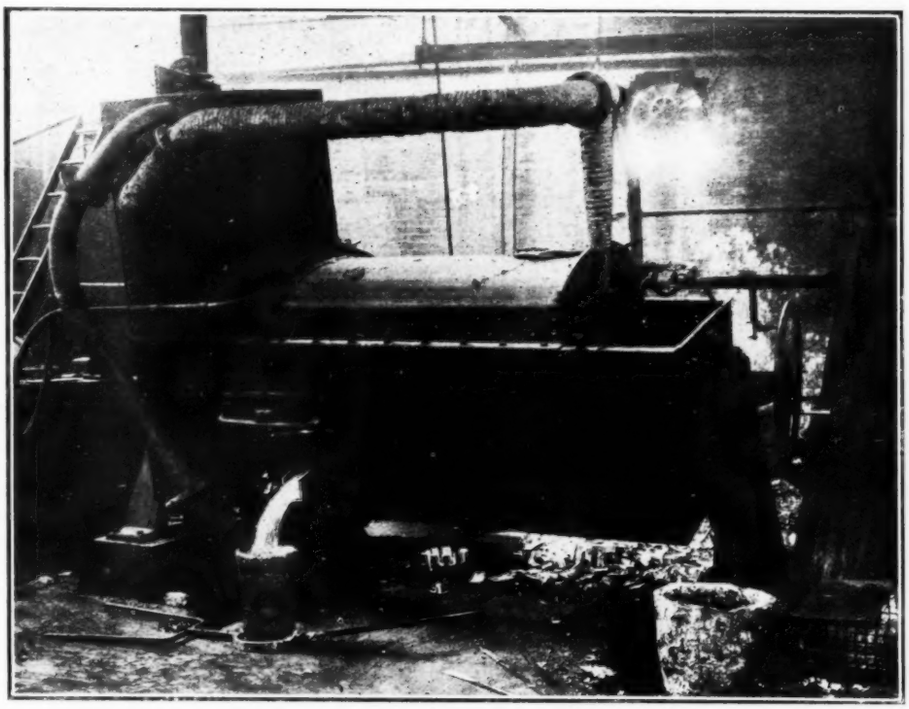


FIG. 1.—AN OIL-FIRED BRITISH REVERBERATORY FURNACE INSTALLED AT THE WORKS OF STERLING METALS, LIMITED.

Thermal Efficiency.

The metal was taken out of the furnace at an average temperature of 700 deg. C.; the heat content of aluminium at this temperature was 495 B.T.U.'s per lb.; the average oil consumption per 100 lbs. of metal melted was 6.58 lbs., and the calorific value of oil was 18,900 B.T.U.'s per lb. (gross). Thus the thermal efficiency was

$$\frac{495 \times 100}{6.58 \times 18{,}900} = 39.8 \text{ per cent.}$$

This is a distinctly high figure for any metallurgical furnace. There are very few reverberatory melting furnaces which show a higher efficiency than 20 per cent., and certainly on solid fuel the efficiency is usually nearer 5 than 20 per cent.

British Reverberatory Furnaces, Limited, are to be congratulated on having designed and put on the market an oil-fired reverberatory furnace showing a definite reduction in melting cost, and this will no doubt be of interest to the light-alloy industry and non-ferrous manufacturers generally.

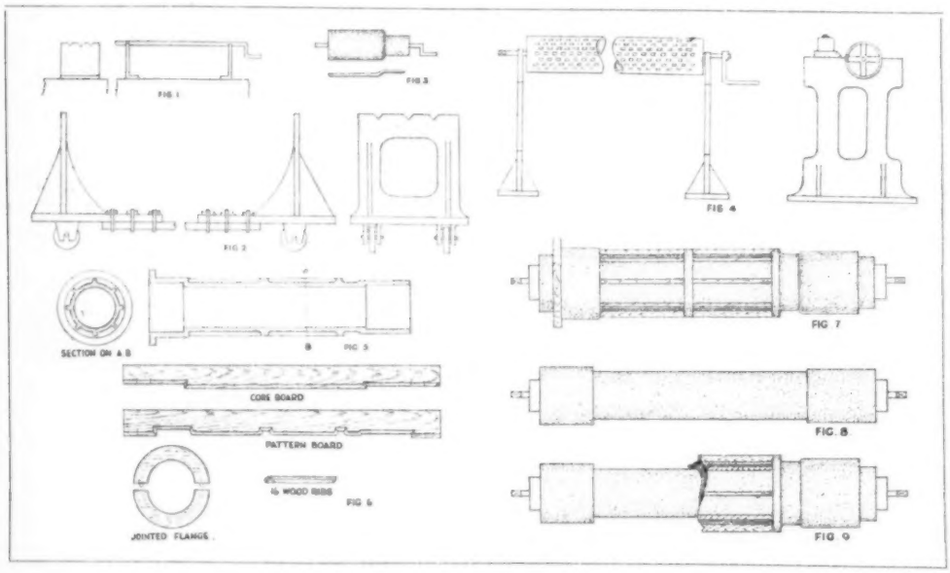
American Scientist Honoured.

The Board of Directors of the American Foundrymen's Association has decided to present to Alexander Ewing Outerbridge, Jun., Philadelphia, the Wm. H. McFadden gold medal. This award has been made in recognition of Mr. Outerbridge's many contributions to the advance of knowledge of cast-iron metallurgy. Mr. Outerbridge was a pioneer in the application of science to the foundry industry and his researches have formed the basis for many developments of great value. Mr. Outerbridge's research work on chilled cast iron, ferro-alloys, mobility of molecules in cast iron, strengths of cast-iron test bars as affected by tumbling and the growth of cast iron have been especially notable. His findings in these researches have been used as the basis for further researches of other workers. He was perhaps the first to see the value of X-rays in examination of castings, for in 1904 he showed examples of X-ray photographs of iron and steel and advocated its use in the examination of castings for defects.

Sweeping Loam Cores and Patterns Horizontally.

By Ben Shaw and James Edgar.

The use of loam has many advantages in the foundry, more particularly in the jobbing foundry rather than the repetition foundry. The material is strong, plastic, and needs no ramming. Its use limits the amount of patternwork that would otherwise be needed, and while it cannot be used profitably in all instances there are certain classes of work for which it is eminently suited. Its primary value is the ease by which it can be swept to a given shape; thus, for cylindrical work its use is both effective and cheap. A profiled edged board is all that is required to form a cylindrical shape. Two methods are adopted in sweeping such shapes; one known as vertical sweeping, in which the profiled edged board is rotated about a spindle, and the second known as horizontal sweeping, the board, in this form of sweeping, being fixed and the loam supported and rotated against it. It is this latter form of sweeping that is referred to more particularly in this article.



Horizontal sweeping in loam is more generally associated with the making of cylindrical cores and to a lesser extent with patterns. The tackle involved depends upon whether the work is to be swept on the bench or on the floor, and this is governed largely by the size of the work. The work is swept on spindles which are rotated in bearings provided in special racks or trestles. Small racks, such as are shown in Fig. 1, are generally used for bench work, while for the largest of work special adjustable trestles are preferred. The form of trestle is shown in Fig. 2, and it will be noted that they are capable of adjustment in length to accommodate various lengths of work, and each is mounted on wheels to form a bogie. This enables the swept work being transported to a drying oven conveniently. The notches at the top edges form the bearings for the spindles. Small work swept on bench racks can easily be removed and transferred to an oven for drying, but this cannot be done satisfactorily with large work.

When the spindle is to be removed from a core before the core is placed in the mould, a layer of straw rope is applied to a clean spindle. In this manner the rope does not adhere as it becomes charred on drying and the core is easily removed from the spindle. The simplest form of spindle is that used for small cores consisting of 1-in. round iron with one end cranked to form a turning handle, as shown in Fig. 1. Cores made on such a spindle are usually removed for placing in the mould, and in order that the core will have sufficient strength they are frequently reinforced with pieces of iron, as in Fig. 3. After some loam has been applied to straw rope covering the spindle, these pieces of iron are bedded in and encircled with wire to keep them in position during the time of subsequent sweeping to give the core the required shape.

For large cores that need special support, the spindle or barrel upon which the core is swept remains in the core until the work has been cast. Were it not for the necessity of forming a compressible core it would be more economical to cover a metal tube or barrel with loam. Many experiments have been made with collapsible core barrels, but few have any practical value. The simplest form probably is that in which a wrought-iron or steel pipe is split along one side the entire length. When the barrel is at its normal size this slot is from $\frac{1}{8}$ to $\frac{1}{4}$ in. wide. This space is sufficient to take up the contraction as the surrounding casting cools. The core barrels in general use are perforated freely with vent holes, either cored, punched or drilled, depending upon whether the barrel is a cast or rolled product. Fluted barrels without vent holes are sometimes used, gases being directed from the ends of the core by way of the flutes. Long core barrels are fitted with journals at each end, as shown in Fig. 4. The tackle necessary for sweeping medium sized work horizontally is indicated in this latter illustration, the sweep being shown in position and weighted to prevent its movement during the time of sweeping the shape required. In order to show the application of this form of sweeping for both patterns and cores, that are cylindrical in shape, it is perhaps profitable to consider its use in the production of a suitable casting.

A representative type of work for which horizontal sweeping is profitably employed is that shown in Fig. 5. It illustrates a rather common form of stern tube usually required in cast iron. The pattern work necessary is almost negligible, and consists of two boards representing the profiles of the outer and inner shape, a jointed flange and a number of small ribs, as shown in Fig. 6. These constitute the work supplied by the pattern shop.

The pattern board, representing the outer shape of the required casting, is usually mounted first for sweeping, and this should be supported on the trestles at the required distance from the barrel. The barrel is rotated in its bearings and straw rope is applied to it, loam being applied at intervals while the rope is being wound round. The process is continued until the rope is about $\frac{1}{2}$ in. from the board profile, when loam only is applied. The loam is carried past the board which sweeps the shape. The first application of loam on the straw rope should be carefully wiped on, otherwise it will drop off as it is being swept. Usually the loam is thinned with water for the final sweeping to give a smooth surface. When this has been completed and dried in an oven it is ready for having the subsidiary pattern sections attached for use as a complete pattern such as is shown in Fig. 7. It is advisable to mark a centre line on this loam pattern for ease in forming the joint when making the sand mould from it.

It is sometimes considered that this form of pattern is only suitable for a "one-off" job, but, providing the loam is protected from the effects of moisture in the moulding sand, it can be used many times. Thus a coating of tar, if the loam pattern is thoroughly dried afterwards, will protect it and make it serviceable for the production of about a dozen moulds.

While the sweeping of the core is similar much more care must be taken in the process. The pattern is only required to withstand the ramming of sand against it; the core must withstand the pressure of metal surrounding it and allow air and gases, generated at the time of casting, a ready exit.

At first the core board is generally set to sweep a diameter about $1\frac{1}{2}$ in. less than the required diameter of the core, loam and straw rope being applied to the spindle until the shape has been roughly swept. This is dried or allowed to stand until the loam has become very stiff before the final sweeping of loam is made. Care must be taken with this final coat to ensure that it binds well. When finally completed and dried it is coated with blackwash to give a good skin to the casting and to facilitate the stripping of the core from the metal surface. The completed core is indicated by Fig. 8. Two barrels are used in order that the production of the core can proceed while the mould is being prepared from the pattern, but it sometimes occurs that a job is required for which only one suitable barrel is available. This difficulty can be surmounted by adopting the principle of thicknessing. In some instances it is profitable to thickness a mould to define the shape of a core; in this instance, however, the thickness can be applied to the core to form the pattern. The core should be prepared in a manner similar to that already referred to, and when it has been thoroughly dried it is mounted on the trestles again and the pattern board set. In order to preserve the core from injury straw rope should be wound round it first, only applying loam after the surface has been completely covered. When the pattern thus formed has been used the thickness is removed from the core and blackwash painted over. This method is only suitable for a "one-off" job, but it is useful in cutting down the cost of that job. The method is clearly indicated in Fig. 9.

Protective Coatings for Pipes.

The report of a sub-committee on pipe coatings presented to the American Gas Association meeting in Chicago contained the following statement of the characteristics of a good material for coating underground pipes to minimise corrosion:—(*a*) The coating material should be impervious to air and moisture; (*b*) it should adhere tenaciously to the surface of the pipe; (*c*) it should not be brittle at 0 deg. C. (32 deg. F.) or soften to such an extent at 60 deg. C. (140 deg. F.) that it will run or rub off during handling; (*d*) it should withstand, without chipping or spalling off, the shocks and abrasion to which the pipe is likely to be subject during transportation and installation; (*e*) the coated pipes should not stick together during transportation; (*f*) the material should be easily applied either in the yard or in the field, and (*g*) the material should be of such a character that any damage occurring in the field can be readily repaired after installation.

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Trade Talk.

GOSSELL & SON, LIMITED, 110, Cannon Street, London, E.C.4, have been appointed the British agents of the Stahlrader G.M.B.H., which has been formed in Germany to deal with the sale of all cast-steel wheels and pairs of wheels and axles for light railways and collieries as produced by all the German works manufacturing these articles.

IN CONNECTION WITH Lord Ashfield's scheme for further speeding-up and increasing the travelling facilities on the London Underground Railways, the British Thomson-Houston Company, Limited, Rugby, has received orders for 367 electro-magnetic automatic control equipments for motor-coaches and 194 control equipments for trailer coaches.

HENRY BATH & SON, LIMITED, Liverpool, intimate that they have transferred the bulk of their Regent Warehouse accommodation from the premises at Duke's Dock, at the South End, which they have occupied for 35 years, to more commodious and up-to-date premises at Benbow Street, Bootle, in the immediate vicinity of the docks at the North End of the Liverpool dock system.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, Kinnaird House, Pall Mall East, London, S.W.1, announce that as a result of the fusion of certain of their interests with those of Vickers, Limited, they will now concentrate their activities at the following establishments:—The Walker Group of Shipyards, Low Walker, Newcastle-upon-Tyne; The Scotswood Group of Works, Newcastle-upon-Tyne; the Close Works, Gateshead-upon-Tyne.

THE COWPEN DRY DOCKS & SHIPBUILDING COMPANY, LIMITED, launched three vessels of a gross tonnage of 8,338, and 4,420 i.h.p. during 1927. Three new ships are presently under order and due for delivery in 1928. They are designed to carry between 8,500 and 9,000 tons. In the company's ship-repairing department 113 vessels have been docked, whilst 355 ships have been repaired afloat. Extensive damage repairs have been executed on numerous cargo steamers and oil tankers.

THE DIRECTORS of the Ropner Shipbuilding and Repairing Company (Stockton) are seeking authority to sell the North Shore Shipyard at Stockton-on-Tees. Sir W. H. Seager, the chairman, in a circular to the shareholders, states that the yard has been closed for a considerable time, and the property is deteriorating. The board has had several offers, and it feels that it should have the approval of the shareholders before it accepts the one it considers best. He believes the board will be able to return to shareholders 2s. per share in cash. The directors are satisfied there is no prospect of re-opening the yard with any hope of making profits.

THE DIRECTORS OF the London Iron and Steel Exchange announce that the scheme for providing new premises for the Exchange is on the point of completion. A lease is now being drawn up by which the Exchange Company takes the whole of one floor of Imrie House, King William Street, E.C.4, and plans have been prepared for converting the premises into comfortably appointed club and meeting rooms. This year's subscription will entitle *existing members* of the Exchange to many advantages which they have not hitherto possessed. The scheme includes the provision of smoking, dining and refreshment rooms and a snack and refreshment counter, in addition to a room for holding meetings. The premises will be comfortably and appropriately furnished, and will contain such conveniences as telephone boxes and writing tables.

Reports and Dividends.

Still Engine Company, Limited.—Loss, £14,995, increasing debit brought forward to £93,086.

Claud Hamilton, Limited.—Preference dividend for year; carry forward, £5,980; no ordinary dividend since 1923.

Allen-Liversidge, Limited.—Interim dividend on ordinary shares, 10 per cent. per annum (5 per cent. actual), less tax.

Bulls Metal & Melloid Company, Limited.—Profit, £368; amount brought in, £751. After allowing £250 for directors' fees, there remains credit balance £501, which directors propose to carry forward.

Armstrong Siddeley Development Company, Limited. Profit, £127,302; brought forward, £37,335; available total, £164,637; dividends, 15 per cent., free of tax, on ordinary shares, and at 6 per cent. on the preference shares; available, £76,157; balance, £88,480; reserve account, £40,000; leaving a carry forward, £48,480; final dividend on preference shares at the rate of 6½ per cent. per annum for the half-year.

Personal.

MR. R. C. IRWIN has joined the board of directors of Settle, Speakman & Company, Limited, coal factors and shippers, of Stoke-on-Trent, London, Liverpool, etc. Mr. Irwin lately retired from the position of secretary of the London Midland and Scottish Railway Company. He was formerly the secretary of the Lancashire and Yorkshire Railway, and during his period of office with that company was in control of fuel purchases.

MR. JAMES GOMER BERRY, J.P., who received a baronetcy in the New Year Honours, is the third son of the late Alderman J. M. Berry, J.P., of Merthyr Tydfil, and is the brother of Lord Buckland and Sir William Berry, Bart. Apart from his newspaper interests, Mr. Berry is a director of John Lysaght, Limited. Mr. James Caird, another new baronet, is a director of William Cory & Son, Limited, the Steamship Owners' Coal Association, Limited, and R. & H. Green & Silley Weir, Limited. Among the new knights we observe the names of Mr. John Reeve Brook, Secretary of the Central Electricity Board, and Mr. T. E. Stanton, Superintendent, Engineering Department, National Physical Laboratory.

MR. R. S. HILTON, widely known in the electrical world as managing director and deputy chairman of Metropolitan-Vickers, has accepted the position of

MR. R. S. HILTON
(*Managing Director of the United Steel Companies, Limited*).

sole managing director of the United Steel Companies, Limited. The United Steel Companies, Limited, are one of the largest industrial combines in this country, among their constituent companies being Steel, Peech and Tozer; Samuel Fox & Company; Frodingham Iron and Steel Company; Workington Iron and Steel Company; Rothervale Collieries; Thos. Butlin & Company; Daniel Doncaster; Martino Steel and Metal Company; United Coke and Chemicals Company, and the United Strip and Bar Mills, Sheffield. Mr. Hilton, who for many years held the dual position of secretary and general manager to the Birmingham Gas Department, associated himself with the Metropolitan Vickers Company in 1918. The very wide experience acquired in these positions in both commercial and manufacturing practice, and those welfare and social activities which are such a distinguishing feature of Metropolitan-Vickers, and which he personally did so much to encourage, should prove of the utmost value in his new position. Mr. R. S. Hilton is also vice-chairman of the council of the British Electrical and Allied Manufacturers' Association.

Wills.

HENDERSON, G., of Colville House, Kelso, iron merchant	£21,062
TARDREW, E. G., ironfounder, of Stanmore, Northam, North Devon	£1,342
NICHOLSON, R. J., a director of John Nicholson & Sons (Sheffield), Limited, Mowbray Steel Works, and of Osborne & Company (Dronfield), Limited	£81,462

Contracts Open.

Durham, January 31.—(3) Cast-iron direction posts; (4) wrought-iron motor signs and symbols; (5) gully grates and frames, etc., for year ending March 31, 1929, for the Durham County Council. Mr. W. J. Merrett, county engineer and surveyor, 43, Old Elvet, Durham.

Johannesburg, February 9.—Fourteen bar frames for engines, class 8, 8A, etc.; two plate frames for engines, class H1 and H2; four rear bar frames for engines, class MJ1; two front bar frames for engines, class MJ1, for the South African Railways and Harbours. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Ref. A.X. 5,720.)

London, S.W.—Aluminium castings and pressings, copperware, enamelled ware, fencing (woven wire and strained iron wire), field forges, hollow ware, nails, stoves, grates, telegraph poles (iron), tinplates, cables, etc., for Army contracts. The Director of Army Contracts, Caxton House (West), Tothill Street, Westminster, S.W.1.

Loughborough, Leics., January 16.—Providing and laying 1½ miles of 15-in. spun cast-iron pipes for the Corporation. Messrs. G. & F. W. Hodson, consulting engineers, Bank Chambers, Loughborough. (Fee, £5 5s., returnable.)

Lytham St. Annes, January 21.—70 rectangular cast-iron street gullies, each with inspection eye and 6-in. outlet, and weighing not less than 3¾ cwt., for the Town Council. Mr. H. Rothwell, town clerk, Town Hall, Lytham St. Annes.

New Delhi, January 16.—A locomotive travelling crane for the Indian Stores Department for the Eastern Bengal Railway, Calcutta. The Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Reference A.X. 5,698.)

Liverpool, January 26.—(E.S. 6) Brass and copper castings, for the Electric Supply Department. Acting City Electrical Engineer, 24, Hatton Garden, Liverpool.

Company Meeting.

William Beardmore & Company, Limited.—The annual meeting of the shareholders was held at Winchester House, Old Broad Street, E.C.2. The RIGHT HON. LORD INVERNAIRN OF STRATHNAIRN, chairman of the company, presided. The chairman said:—We are continually keeping abreast of the latest developments pertaining to all our manufactures, and in pursuance of this policy I am glad to be able to inform you we have recently acquired a sole licence for the manufacture and sale in this country of Caprotti valve gears for locomotives and marine purposes. On recent official tests an L.M.S. locomotive, fitted with the Beardmore Caprotti valve gear, gave an economy in fuel of over 20 per cent. as compared with a precisely similar type of engine fitted with standard valve gear. In addition to the saving on fuel, this gear shows substantial economies in the running costs of locomotives. The introduction of this gear has aroused universal interest, and a considerable number of orders have been received. When a saving on fuel alone approximating 20 per cent. can be effected by the adoption and fitting of this gear, it is obvious that no railway company either at home or abroad can afford to ignore the introduction of this particular gear. I am confident, therefore, that this development will bring a large volume of work to our plant and prove to be a source of considerable revenue to the company. This type of gear has also been applied to marine engines, and relatively satisfactory results are anticipated. We have also acquired through one of our subsidiary companies a licence for the manufacture in this country of the Bauer-Wach system of marine propulsion, which has proved highly successful on several ships fitted with this system on the Continent. The Bauer-Wach system, worked in conjunction with the Caprotti valve gear, shows a high percentage of economy in the operating costs of ship propulsion, and, in my opinion, should open up a new field for the reciprocating steam engine. On the other side of our business we have developed and perfected in conjunction with one of the pioneers of rustless steel production a rustless steel which is proving of considerable interest, particularly to chemical manufacturers and others who require a steel not subject to corrosion from chemicals, etc.

THE PEARSON AND KNOWLES COAL AND IRON COMPANY, LIMITED, have disposed of the whole of their controlling share interest in Burnell & Company, Limited, and Sir W. Peter Rylands, who represented the group, has resigned his seat on the board.

"SERVICE GRC FIRST"

TO EVERY BRITISH STEELFOUNDER WE WISH—

"SUCCESS IN 1928!"

THIS CAN BE ASSURED IF YOU USE ONLY

"YORKSHIRE SAND"

IN YOUR FOUNDRIES. YOU WILL SAVE MONEY AND MAKE MONEY IF YOU HAVE RESOLVED TO

BUY ONLY BRITISH SANDS

There is no need to send your money abroad for sands when

"YORKSHIRE SAND"

will do as much, and more, than any imported sand.

MADE IN FOUR GRADES, TO SUIT EACH AND EVERY CLASS OF WORK, EASY TO USE, NO VEXATIOUS DELAY IN DELIVERY AND MUCH CHEAPER IN THE LONG RUN.

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Telephone: 22311 *Sheffield* (3 *lines*). *Telegrams: Refractory, Sheffield.*

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—A general survey of the markets for raw material in the opening week of the New Year, and that on Tees-side particularly, discloses a very slow recovery of business after the holidays, with very few changes of importance as far as prices and fresh contracts are actually concerned. Accepting Cleveland as the leading market, it must not be forgotten that as a matter of custom the Christmas suspension usually extends over a longer interval than is the case in the Midlands, and although production of pig-iron is by no means entirely closed down, furnace outputs are on a rather more restricted scale than the average normal tonnage. Consequently there has been some slight accumulation of stocks in makers' yards, but this has not been of serious dimensions and will soon be liquidated when active market operations are resumed. On the export side it is now possible to give the final figures of the Tees exports of iron and steel for the past year, which total 1,025,753 tons, which compares with 647,209 tons in 1926, 999,045 tons in 1925, and 1,089,843 tons in 1924. Of this aggregate, however, it is disappointing to record that last year the exports of pig-iron from the Tees only reached 167,181 tons, whereas the tonnage of 858,572 tons of manufactured iron and steel exceeds any previous post-war year by over 200,000 tons, and is, in fact, the heaviest tonnage in the history of Tees-side. Current quotations remain as follow:—No. 1 Cleveland foundry, 67s. 6d. per ton; No. 3 Cleveland G.M.B., 65s.; No. 4 foundry, 64s.; No. 4 forge, 63s. 6d. per ton.

Conditions in the East Coast hematite market are distinctly brighter than has been the case for some time past, both home and export demand indicating more active buying, while there is less price-cutting competition among producers. Some fairly good orders from Italy are reported, and local makers have some big contracts still to execute for South Wales. Prices are variable, but about the average quotation may be taken at 70s. 6d. for mixed numbers and 71s. for No. 1 grade. On the North-West Coast the price is slightly lower at 70s. for Bessemer mixed numbers.

LANCASHIRE.—Only a limited volume of business has been passing in the local markets for foundry pig, with prices practically unchanged. Midland brands are on offer at from 73s. to 73s. 6d. for Derbyshire No. 3, and from 72s. 6d. to 72s. 9d. per ton for Staffordshire makes, with Cleveland quoted as before at 78s. 2d., Scottish at 87s. 6d. to 88s., and West Coast hematite at round 85s. per ton, all delivered Manchester or equal distance.

THE MIDLANDS.—The trade outlook in South Staffordshire and the adjacent districts is as yet too indefinite to estimate future possibilities, and for the present consumers of foundry pig in local markets seem reluctant to add to commitments until the position becomes somewhat less obscure. Prices so far are unchanged, No. 3 Northampton iron being offered at 58s. 6d. to 59s. 6d. per ton, and Derbyshire from 64s. to 65s. at furnaces. North Staffordshire No. 3 iron is on offer at the Derbyshire figures, Lincolnshire No. 3 at 73s. 6d. per ton delivered local stations, and No. 3 Scotch iron round about 90s.

SCOTLAND.—As indicating the depressed state of the Scotch pig-iron market, the announcement is made that nine blast-furnaces have been damped down; of these, three were on ordinary, three on basic and three on hematite. This curtailment has been expected for some time, and the move may be carried further by other makers.

Finished Iron.

Manufacturers of this class of material continue at a disadvantage in regard to new contracts and orders in hand, conditions with which they have already been too long familiar, and for the present mill and forge owners in the Black Country districts are only operating works on the usual restricted scale. In this area there is still keen competition for what little business is developing for crown bars and cheaper grades. The former are quoted by Lancashire, Derbyshire and certain Staffordshire works as low as £9 5s. per ton delivered, but other Staffordshire mills will not touch this figure. Bolt iron has been quoted at under £9, but even at this low level they are not able to secure much support on account of the prevailing Continental competition. The foreign product is being offered quite freely at £5 17s. 6d. per ton, delivered works in the Black Country area. Marked bars are now at £12 10s. per ton, and the makers of this class of iron are moderately occupied.

Steel.

The various markets for steel and semi-products have not as yet experienced the expected stimulus of the improvement in the shipbuilding industry, but it is stated on official authority that questions of prices are to be discussed by the several Associations representing the industry almost immediately, which may probably have advantageous results in the near future. Meanwhile, in the Sheffield market there is not at the moment much business passing. Dealings in acid billets are better than in basic, which are in slow demand. Siemens' acid billets are unchanged at £10 per ton delivered, and quotations for basic qualities are:—Soft, £6 10s.; semi-hard, £7 10s.; medium, £7 12s. 6d.; hard, £8 2s. 6d. per ton, delivered. Steel hoops are £9 10s. to £10. In the tinplate market, judging by recent inquiries, some good business may reasonably be expected; indeed, several fair orders have already been fixed up at over the minimum selling price of 17s. 9d., for delivery over the next few months.

Metals.

Copper.—The buoyancy evidenced in the market for warrant copper in the closing weeks of the past year has so far continued unchecked, despite the fact that consumption of the metal is usually below normal volume at this season, purchases being mostly confined to current requirements. The strength of the European position lies in the limited stocks in England and France, which at the end of November amounted to only 14,531 tons, whereas a year ago the figure was 44,806 tons.

Official closing prices of standard copper have been as follow :—

Cash : Thursday, £62 1s. 3d. to £62 2s. 6d.; Friday, £62 to £62 1s. 3d.; Monday, £61 17s. 6d. to £61 18s. 9d.; Tuesday, £61 13s. 9d. to £61 15s.; Wednesday, £61 2s. 6d. to £61 3s. 9d.

Three Months : Thursday, £62 1s. 3d. to £62 2s. 6d.; Friday, £62 to £62 1s. 3d.; Monday, £61 16s. 3d. to £61 17s. 6d.; Tuesday, £61 11s. 3d. to £61 12s. 6d.; Wednesday, £61 1s. 3d. to £61 2s. 6d.

Tin.—In contrast with the active conditions recorded above, standard cash tin has experienced a continuous set-back since the reopening after the holidays, quotations having fallen approximately £7 since the start of the year. The position has been uncertain for some time in the absence of a new lead on the part of the professional element, whose attitude is hesitating pending further developments in the Transatlantic market. Fluctuations in values were restricted prior to the holidays, but the market has since been affected apparently by the steady increase in the home stocks.

Official closing prices of standard tin have been as under :—

Cash : Thursday, £256 15s. to £257; Friday, £265 15s. to £267; Monday, £258 to £258 2s. 6d.; Tuesday, £254 10s. to £254 15s.; Wednesday, £254 5s. to £254 10s.

Three Months : Thursday, £256 7s. 6d. to £256 10s.; Friday, £255 15s. to £256; Monday, £257 5s. to £257 7s. 6d.; Tuesday, £254 to £254 5s.; Wednesday, £252 15s. to £253.

Spelter.—Consistently steady may best describe conditions in the market for ordinary spelter, with fluctuations in values comparatively unimportant in range. A merchant firm points out that consumptive interest has been negligible, and dealing on 'Change largely professional. American spelter is still offered here and operates against any material rise in the London market. The undertone here, however, is comparatively firm, and support is invariably forthcoming whenever prices show an inclination to decline.

The following are the week's prices :—

Ordinary : Thursday, £26 5s.; Friday, £26 2s. 6d.; Monday, £26 3s. 9d.; Tuesday, £26 2s. 6d.; Wednesday, £26.

Lead.—Purchases of soft foreign pig of late have been on a moderate scale, but selling orders are easily absorbed, and with but few sellers the market is fairly firm, although consumers purchase only limited quantities. The shipments from Australia for November were not so heavy, and, with no pressure of American offers to European ports, there is rather more confidence in the stability of the market.

The week's prices are appended :—

Soft foreign (prompt) : Thursday, £22; Friday, £21 18s. 9d.; Monday, £21 18s. 9d.; Tuesday, £21 18s. 9d.; Wednesday, £21 16s. 3d.

AUCTION SALE.
(See also Advertisement Page 18.)

IMPORTANT SIX DAYS' SALE OF THE ENTIRE CONTENTS OF THE GLOBE IRON WORKS OF JOHN MUSGRAVE & SONS, LTD., BOLTON, LANCS.

MESSRS. FULLER, HORSEY, SONS & CASSELL will Sell by Auction, in Lots, on the Premises, on TUESDAY, JANUARY 31, 1928, and following days, at 11 o'clock precisely each day,

HIGH-CLASS MACHINE TOOLS,
including 70 Screw-cutting and other Lathes, 10 Combination and other Turret and Capstan Lathes, by Herbert, Brown & Sharpe, etc., Potter & Johnston & Cleveland Automatics, 24 Horizontal and Vertical Milling Machines, by Brown & Sharpe, Le Blond, Kendall & Gent, Becker and others, 4 Plano-type ditto, 9 Planing Machines up to 30 ft. x 10 ft. x 10 ft., 6 Side-Planers up to 13 ft. x 9 ft. 6 in., 7 Universal, Plain and Surface Grinders, by Brown & Sharpe, Norton, Churchill, etc., Disc and Tool and Cutter Grinders, various, 10 Pearn-Richards No. 4 and other Horizontal Boring Machines, 9 Duplex and other Vertical Boring and Turning Mills, by Bullard, Richards, etc., 25 Radial, Pillar and Sensitive Drilling Machines, Noble & Lund 48-in. Band Saw, Haigh 7 ft. Broaching Machine, Richards' Key Seater, Power Hack Saws.

FOUNDRY PLANT,
including Six Cupolas, Two Bonvillain Hydraulic Moulding Machines, 8 ft. Loam Mill, Four Loam Mixers, Wright Tilting Furnace, Foundry Boxes, Ladles, etc.

SHEET METAL PLANT,
including 6 ft. and 3 ft. Power Guillotines, Two Power Stamping Presses, Rhodes' 48-in. Circle Cutter, 6-ft Folder, Rhodes' Nibbler, Tinmen's Rolls, Swaging Machines, Acetylene Plant, etc.

WOOD-WORKING MACHINERY,
including Two Robinson 24-in. Circular Saw Benches, Two 30-in. Band Saws, Two Robinson 24 in. by 6 in. Planing and Thicknessing Machines, 24 in. and 12 in. Overhead Planers, Oliver 36-in. Double Disc Sander, Saw Filing, Plane, Iron, and other Grinding Machines, Universal Trimmers, etc.

MOTIVE POWER,
including Forty 460-volt D.C. Motors, 5 h.p. to 140 h.p., Forty-three 400/440-volt A.C. Motors, 3-phase, 50 periods, 7½ h.p. to 200 h.p., Crompton 6¼ K.V.A., 440-volt, 3-phase Alternator, 12 K.W. 110-volt Motor Generating Set, Lancashire Boiler, by Musgrave, 8 ft. by 30 ft. 170 lb. w.p.) with Superheater, Green's 120-tube Economiser, Bennis Coal Elevator.

MISCELLANEOUS PLANT,
A 20-ton Wagon Weighbridge, 12 Avery Weighing Machines (5 cwt. to 3 tons), Musgrave 2-stage Air Compressor, Broom & Wade 2-cylinder Compressor, Air Receivers, Massey 1-cwt. Pneumatic Hammer, 100-ton Hydraulic Mandrel Press, Dorman Die-Casting Machine, Two Monometer Metal Furnaces, Avery 30-ton Universal Testing Machine, Izod Impact Tester, Newall 4-ft. Measuring Machine, Air Pump and Pipe Testing Plant, Bar Stretching, Bending and Straightening Presses, Laboratory Apparatus, Gas Furnaces, Heating Plant, Tanks up to 37 ft. by 32 ft. by 3 ft., Pumps, Fans and Blowers, Cylinder Boring Engines and Bars, Marking-off Tables, Hydraulic Jacks, Engineers' Small Tools, Shafting, Belting, Winches, Baulk Timber, etc.

STORES AND MATERIALS,
including New Plummer Blocks and Shafting, Fittings, Tool and Mild Steel, Metal Bars various, Nuts, Bolts, Tinned and Black Steel Sheets, Pig-iron, Electrical Fittings, and large quantity NON-FERROUS METAL AND WROUGHT AND CAST SCRAP.

Office Furniture, including Typewriters, Time Recorders, Five Dictaphones, Safes, Drawing Office Equipment, Two Kodak Photostats, and numerous other effects.

May be viewed on production of Catalogue, to be obtained (when ready) of MESSRS. FULLER, HORSEY, SONS & CASSELL, Mechanical Auctioneers and Valuers, 11, Billiter Square, E.C.3.

TO USERS OF STEAM POWER.

MESSRS. FULLER, HORSEY, SONS & CASSELL will include in the above Sale A NEW 450-H.P. COMPOUND TANDEM HEAT EXTRACTION ENGINE,
by Musgrave. Cylinders 18½ in. and 22 in. by 2 ft. (working pressure 170 lb.), with Jet Condensing Plant. Catalogues may be had as in preceding advertisement.

THESE IMPORTANT FOUNDRIES

USE Sterling BOXES

MESSRS. STERLING METALS, LTD., COVENTRY.

BECAUSE THEY SPEED UP PRODUCTION; TURN OUT BETTER CASTINGS; SAVE LABOUR AND MAKE FOR GENERAL ALL-ROUND EFFICIENCY IN THE FOUNDRY.

MESSRS. HENRY WALLWORK & CO., LTD., MANCHESTER.

- **THE ONLY MOULDING BOX MADE FROM SOLID RIBBED ROLLED STEEL**
- **SUPPLIED TO YOUR OWN SPECIFICATION.**
- **WILL MEET ALL MODERN FOUNDRY REQUIREMENTS.**

MESSRS. DEWRANCE & CO., LONDON.

STERLING FOUNDRY SPECIALTIES LTD.

Telephone: 3345 BEDFORD.
Telegrams: "STERFLASK," BEDFORD.
Code: WESTERN UNION.

BEDFORD

London Office: 13, VICTORIA STREET, S.W.1.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	61	2	6
Three months	61	1	3
Electrolytic	66	10	0
Tough	65	5	0
Best selected	65	15	0
Sheets	92	0	0
India	77	0	0
Wire bars	67	0	0
Do. January	66	15	0
Do. February	66	15	0
Ingot bars	66	15	0
H.C. Wire rods	71	0	0
Off. av. cash, Dec.	60	2	3
Do. 3 mths., Dec.	60	5	7½
Do., Sttlmnt., Dec.	60	1	10½
Do., Electro, Dec.	66	8	4
Do., B.S., Dec.	65	9	2
Aver. spot price, copper, Dec.	60	2	3
Do., Wire bars, Dec.	66	13	1½
Solid drawn tubes			12¾d.
Brazed tubes			12½d.
Wire			9½d.

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g.	10½d.
Wire	9¾d.
Rolled metal	9½d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	254	5	0
Three months	252	15	0
English	253	15	0
Bars	255	15	0
Straits	254	15	0
Australian	255	5	0
Eastern	260	5	0
Banca	254	15	0
Off. av. cash, Dec.	267	4	10½
Do., 3 mths., Dec.	263	9	7½
Do., Sttlmt., Dec.	267	4	7½
Aver. spot, Dec.	267	4	10½

SPELTER.

	£	s.	d.
Ordinary	26	0	0
Remelted	26	10	0
Hard	20	10	0
Electro 99.9	31	0	0
English	26	10	0
India	22	5	0
Zinc dust	33	0	0
Zinc ashes	9	0	0
Off. aver., Dec.	26	4	8½
Aver., spot, Dec.	26	7	3

LEAD.

	£	s.	d.
Soft foreign ppt.	21	16	3
English	23	5	0
Off. average, Dec.	22	6	0¾
Average spot, Dec.	22	3	3

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	35	0	0
Do. V.M. ex whf.	33	0	0
Rods	41	15	0
Boiler plates	30	10	0
Battery plates	32	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	64	10	0
Chinese	46	0	0
Crude	37	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	8	17	6
45/50%	12	17	6
75%	20	10	0
Ferro-vanadium—			
35/40%	14/3 lb. va.		
Ferro-molybdenum—			
70/75% c. free	5/- lb.		
Ferro-titanium—			
23/25% carbonless	11½d.		
Ferro-phosphorus, 20/25%	£17	0	0
Ferro-tungsten—			
80/85%, c. fr.	1/3 lb.		
Tungsten metal powder—			
98/99%	1/8 lb.		
Ferro-chrome—			
2/4% car.	£33	10	0
4/6% car.	£23	2	6
6/8% car.	£22	17	6
8/10% car.	£22	5	0
Ferro-chrome—			
Max. 2% car.	£35	17	6
Max. 1% car	£41	10	0
Max. 0.70% car	£53	0	0
70% carbonless	1/4 lb.		
Nickel—99%, cubes or pellets	£170 0 0 to £175 0 0		
Ferro-cobalt	9/3 lb.		
Aluminium 98/99%	£105	0	0
Metallic chromium—			
96/98%	2/11 lb.		
Ferro-manganese (net)—			
76/80%, loose	£13	10	0
76/80%, packed	£14	10	0
76/80%, export	£13	0	0
Metallic manganese—			
94/96%, carbonless	1/10 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	£	s.	d.
Finished bars, 14% tungsten	£0	2	6
Finished bars, 18% tungsten	£0	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{7}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/-lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

Scrap from high-speed tool steel—

Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Hvy. steel	3	0	0	to	3	2	6
Bundled steel and shrngs.	2	14	0	to	2	18	6
Mixed iron and steel	2	14	0	to	2	15	0
Heavy cast iron	2	18	6	to	3	0	0
Good machinery for foundries	3	0	0	to	3	2	6
Cleveland—							
Heavy steel					2	15	0
Steel turnings					2	6	0
Cast iron borings					2	3	0
Heavy forge					3	12	6
Bushelled scrap					3	2	6
Cast-iron scrap	3	3	6	to	3	6	0
Lancashire—							
Cast-iron scrap					3	5	0
Hvy. wrought					3	2	6
Steel turnings					2	2	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	51	0	0
Brass (clean)	38	0	0
Lead (less usual draft)	19	10	0
Tea lead	16	0	0
Zinc	17	0	0
New aluminium cuttings	76	0	0
Braziery copper	47	0	0
Gunmetal	48	0	0
Hollow pewter	170	0	0
Shaped black pewter	130	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

	£	s.	d.		£	s.	d.
N.E. Coast—							
Foundry No. 1					67/6		
Foundry No. 3					65/-		
Foundry No. 4					64/-		
Forge No. 4					63/6		
Hematite No. 1					71/-		
Hematite M/Nos.					70/6		
N.W. Coast—							
Hem. M/Nos. d/d Glas.					83/-		
,, d/d Birm.	89/-			to	90/-		
Midlands—							
Staffs. common*					—		
,, No. 4 forge					62/6		
,, No. 3 fdry.	64/-			to	65/-		
Shrops. basic					—		
,, Cold blast, ord.*					—		
,, ,, roll iron*					—		
* d/d Birmingham.							
Northants forge					54/-		
,, fdry. No. 3	58/6			to	59/6		
Derbyshire forge					60/-		
,, fdry. No. 3	64/-			to	65/-		
,, basic					—		
Scotland—							
Foundry No. 1					—		
,, No. 3					70/6		
Hem. M/Nos.					74/6		
Sheffield (d/d district)—							
Derby forge					64/-		
,, fdry. No. 3					68/-		
Lincs. forge					64/-		
,, fdry. No. 3					68/-		
E.C. hematite					82/6		
W.C. hematite					87/6		
Lincs. (at furnaces)—							
Forge No. 4					—		
Foundry No. 3					—		
Basic					—		
Lancashire (d/d eq. Man.)—							
Derby forge					—		
,, fdry. No. 3					73/3		
Northants foundry No. 3					—		
Dalzell, No. 3	100/-			to	102/6		
Summerlee, No. 3	88/-			to	94/-		
Glengarnock, No. 3	88/-			to	94/-		
Gartsherrie, No. 3	88/-			to	94/-		
Monkland, No. 3	88/-			to	94/-		
Coltness, No. 3	88/-			to	94/-		
Shotts, No. 3	88/-			to	94/-		

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.) nom.	9	5	0	to	10	10	0
Angles					—		
Tees to 3 united ins.					—		
Nut and bolt iron					9	0	0
Hoops					12	10	0
Marked bars (Staffs.) f.o.t.					12	10	0
Gas strip					12	0	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	2	6	to	8	7	6
Boiler plts.					10	10	0
Chequer plts.					10	5	0
Angles					7	12	6
Tees					8	12	6
Joists					7	12	6
Rounds and squares, 3 in. to 5½ in.					7	15	0
Rounds under 3 in. to ⅜ in. (Untested)					8	0	0
					and upwards		
Flats, over 5 in. wide and up					9	2	6
Flats, 5 in. to 1½ in.					8	2	6
Rails, heavy	8	2	6	to	8	7	6
Fishplates					12	10	0
Hoops (Staffs.)					10	10	0
Black sheets, 24g.					10	2	6
Galv. cor. shts., 24g.					13	0	0
Galv. fencing wire 8g. plain					12	10	0
Billets, soft	£6	0	0	to	6	10	0
Billets, hard					8	2	6
Sheet bars	£5	12	6	to	5	15	0
Tin bars	£5	12	6	to	5	15	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 2½
Sheet to 10 w.g.	1 3
Wire	1 3¾
Rods	1 3
Tubes	1 8½
Castings	1 2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	19.76
No. 2 foundry, Valley	17.25
No. 2 foundry, Birm.	16.00
Basic	18.76
Bessemer	19.26
Malleable	18.26
Grey forge	18.51
Ferro-mang. 80% d/d	100.00
Bess rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.80
Skelp, sheared steel	1.80
Steel hoops	2.20
Sheets, black, No. 24	2.80
Sheets, galv., No. 24	3.65
Sheets, blue an'l'd., 9 and 10	2.10
Wire nails	2.50
Plain wire	2.40
Barbed wire, galv.	3.20
Tinplate, 100 lb. box	$5.25

COKE (at ovens).

Welsh foundry	—
,, furnace	—
Durham and North.	
,, foundry	—
,, furnace	13/6
Other Districts, foundry	—
,, ,, furnace (basis)	12/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14	box	18/3	
,,	28×20	,,	36/6	
,,	20×10	,,	—	
,,	18¾×14	,,	—	
C.W.	20×14	,,	17/4½	
,,	28×20	,,	—	
,,	20×10	,,	—	
,,	18¾×14	,,	—	
Terneplates	28×20	—	per box basis f.o.b.	

SWEDISH IRON.

	£	s.	d.		£	s.	d.
Bars, hammered, £18 10 0 to 19 0 0							
Rolled Ord.	15	0	0	to	15	10	0
Nail rods	15	7	6	to	15	15	0
Keg. steel nom.					33	to	£35
Faggot steel nom.					£22	to	£25

Blooms, according to quality £8 to £12
Pig-iron £5 15 0 to
all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	Fittings.
Gas	67½%	45%
Water	63¾%	40%
Steam	60%	35%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Jan. 5 ..	62	1	3	inc.	6/3
,, 6 ..	62	0	0	dec.	1/3
,, 9 ..	61	17	6	,,	2/6
,, 10 ..	61	13	9	,,	3/9
,, 11 ..	61	2	6	,,	11/3

Electrolytic Copper.

	£	s.	d.	
Jan. 5 ..	66	10	0	No change
,, 6 ..	66	15	0	inc. 5/-
,, 9 ..	66	15	0	No change
,, 10 ..	66	10	0	dec. 5/-
,, 11 ..	66	10	0	No change

Standard Tin (cash).

	£	s.	d.	
Jan. 5 ..	256	15	0	dec. 40/-
,, 6 ..	256	15	0	No change
,, 9 ..	258	0	0	inc. 25/-
,, 10 ..	254	10	0	dec. 70/-
,, 11 ..	254	5	0	,, 5/-

Tin (English ingots).

	£	s.	d.	
Jan. 5 ..	256	0	0	dec. 40/-
,, 6 ..	255	15	0	,, 5/-
,, 9 ..	257	0	0	inc. 25/-
,, 10 ..	253	15	0	dec. 65/-
,, 11 ..	253	15	0	No change

Zinc Sheets (English).

	£	s.	d.	
Jan. 5 ..	35	0	0	No change
,, 6 ..	35	0	0	,, ,,
,, 9 ..	35	0	0	,, ,,
,, 10 ..	35	0	0	,, ,,
,, 11 ..	35	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Jan. 5 ..	26	5	0	inc. 1/3
,, 6 ..	26	2	6	dec. 2/6
,, 9 ..	26	3	9	inc. 1/3
,, 10 ..	26	2	6	dec. 1/3
,, 11 ..	26	0	0	,, 2/6

Lead (English).

	£	s.	d.	
Jan. 5 ..	23	10	0	No change
,, 6 ..	23	10	0	,, ,,
,, 9 ..	23	10	0	,, ,,
,, 10 ..	23	5	0	dec. 5/-
,, 11 ..	23	5	0	No change

AVERAGE MONTHLY PRICES OF MARKED BARS (SOUTH STAFFS).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1897 ...	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0
1898 ...	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	8 0 0	8 0 0	7 11 8
1899 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	9 0 0	9 0 0	9 10 0	10 0 0	10 0 0	10 0 0	8 3 4
1900 ...	11 0 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 10
1901 ...	9 10 0	9 10 0	9 10 0	9 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 16 8
1902 ...	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 7 6
1903 ...	8 5 0	8 5 0	8 5 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 8 9
1904 ...	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 10
1905 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	8 1 8
1906 ...	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	8 15 10
1907 ...	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0
1908 ...	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 5 10
1909 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1910 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1911 ...	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1912 ...	8 10 0	8 10 0	8 10 0	8 15 0	9 0 0	9 0 0	9 0 0	9 8 0	9 10 0	9 10 0	9 10 0	9 15 0	9 1 6
1913 ...	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	9 10 0	9 10 0	9 4 0	9 0 0	9 0 0	9 13 8
1914 ...	8 12 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 14 4
1915 ...	9 0 0	9 0 0	9 3 0	10 2 0	10 15 0	11 10 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	13 10 0	11 5 0
1916 ...	13 10 0	13 10 0	14 13 0	15 0 0	15 0 0	15 0 0	15 0 0	15 10 0	15 10 0	15 0 0	15 10 0	15 0 0	14 18 7
1917 ...	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0
1918 ...	15 12 6	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	17 0 0	17 0 0	17 0 0	16 6 3
1919 ...	18 0 0	18 10 0	20 0 0	20 0 0	23 0 0	23 0 0	23 0 0	24 12 0	25 0 0	25 0 0	25 0 0	25 5 0	22 10 7
1920 ...	26 17 6	27 0 0	28 0 0	30 5 0	30 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	31 10 2
1921 ...	31 10 0	30 3 4	27 10 0	27 10 0	27 10 0	24 15 0	21 0 0	20 0 0	20 0 0	17 10 0	17 0 0	16 0 0	23 7 4
1922 ...	16 0 0	14 17 6	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 18 1
1923 ...	13 10 0	13 10 0	13 16 0	14 7 6	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 5 3½
1924 ...	14 10 0	14 10 0	14 10 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 17 6	14 17 3½
1925 ...	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 13 4½	
1926 ...	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	—*	14 10 0	14 0 0
1927 ...	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 0 0	13 0 0	12 18 0	13 15 8

* No quotation available.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
ROYAL BLDS., FISHER ST., SWANSEA.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
20, SECOND LINE BEACH, MADRAS.
1, HONG KONG ROAD, SHANGHAI.

REGISTERED TRADE MARK
LIMPET

OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR.
5, SHAFFRAZ ROAD, RANGOON
NADIR HOUSE, MACLEOD ROAD, KARACHI.
1 SHAREH SONK EL TEWFIKIEH, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

SITUATIONS VACANT AND WANTED.

MOULDER.—Assistant Foreman required for Steel Foundry with Siemens-Martin Acid Steel Furnaces; must have had first-class experience in medium weight and light castings, including Turbine and Valve Castings; also experienced in modern Machine Moulding practice.—Apply, stating full particulars of experience and age, to "Moulder," WM. PORTEOUS & COMPANY, Advertising Agents, Glasgow.

WANTED, experienced Iron Moulders, accustomed to heavy ornamental castings.—Apply, Box 562, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ABRASIVE WHEELS, ETC.—Large Manufacturing Concern with world-wide reputation requires energetic Representatives; proved selling ability and personal connection among Engineers, etc., essential; applications should contain full details, references, etc.—Write, Box 574, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THE GOVERNMENT OF INDIA require TWO INSPECTORS OF STORES (STRUCTURAL)

for service in the Indian Stores Department. Candidates must possess a University degree in Engineering, or good general education up to the standard of the Institution of Civil Engineers or of the Institution of Mechanical Engineers, and drawing office experience, and have served a regular apprenticeship in structural engineering workshops. It is essential that they should have specialised in structural steel and bridge work. Age preferably between 24 and 28 years of age.

Agreement for five years in the first instance. Pay at the rate of Rs. 500, rising by annual increments of Rs. 50 to Rs. 750 a calendar month, with certain allowances. Free first-class passage to India. Provident Fund.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor Gardens, London, S.W.1. Last date for receipt of applications 28th January, 1928.

CHEMIST (Junior) required by large Motor Engineering Firm, having experience in Ferrous and Non-Ferrous Metals; knowledge of Metallurgy and Heat Treatment an advantage.—Reply, stating age, experience and salary required, Box 568, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

AGENCIES.

AGENT wanted; Sale of all classes Foundry Pig-iron; must have good connection throughout Midland district; only experienced man considered.—Apply, stating terms and references, to Box 566, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

AGENTS ON COMMISSION, OR DISTRIBUTORS, wanted, all parts, calling on Foundries, for the Sale of "Metallic Phosphoro."—Write CHAS. HALL, 746, Seventh Street, Buffalo, N.Y., U.S.A.

PROPERTY.

11 ACRES WORKS SITE—SHEFFIELD. 145,000 sq. ft. of SHOPPING, compact and convenient. Siding connections with L.M. & S. and L. & N.E. Rlys. Well-built and commodious Offices. Will sell whole or in lots to suit customers, or let on favourable terms. Unique opportunity for manufacturers.

Apply,

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

PATENTS AND TRADE MARKS.

INFORMATION HANDBOOKS, Advice, and Cons. free; King's Patent Agency, Ltd.—B. T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146A, Queen Victoria Street, E.C.4. 40 years' refs. 'Phone: 0682 Central.

AUCTION SALE.

(*See also Editorial Page* 36.)

MANCHESTER.

Re Wm. Munslow, Limited (Ironfounders), in Voluntary Liquidation.

LOMAX, SONS & MILLS have received instructions from the Liquidator herein to offer for SALE BY AUCTION, in ONE LOT, at the ESTATE EXCHANGE, 46, FOUNTAIN STREET, MANCHESTER, on TUESDAY, the 24th JANUARY, 1928, at 3 o'clock in the afternoon, subject to Conditions of Sale to be there and then produced, the old-established

FOUNDRY and PREMISES,

known as NEW STREET FOUNDRY, MILES PLATTING, MANCHESTER, in the occupation of Messrs. William Munslow, Limited.

The SITE contains 3,753 square yards or thereabouts and is leasehold for the residue of a term of 999 years from 1873, subject to an annual rent of £62 11s.

The BUILDINGS, part one and part two storeys in height, comprise Foundries, Core, Dressing and Machine Shops, Sand Mixing, Cupola and Power Houses, Stables, Open Sheds, Offices, etc., and contain a floor area of upwards of 3,000 square yards.

The ELECTRIC MOTIVE POWER, PLANT and MACHINERY consists of Six Electric Motors from 5 to 20 h.p.; Water, Gas and Electric Lighting Services; 10-cwt. Metal Hoist; three Cupolas (combined output 12 tons per hour); Charging Stages; No. 4 "Roots" Blower; Cased Fan and Piping; six Geared Ladles from 8-cwt. to 8-ton capacity; Shank Ladles; Loam Mixing Mill; two Turnover Moulding Machines; Core and Annealing Stoves; Steel Tups; Dressing and Grinding Machines; three Pillar Jib Cranes; 15, 10, 5 and two 2-ton Electric Overhead and Hand Travelling Cranes; Smiths' Hearth and Tools; Tramway; 12-in. and 6-in. centres Lathes; Vertical Drilling Machine; 30-in. Planer; Saw Bench; 10-ton Wagon Weighbridge; Bar Testing Machine; about 150 tons of Moulding Boxes, 70 tons Weights; 20 tons Floor Plates, 10 tons Gaggers, etc.; Racks, Cupboards, Benches, Tanks, Chains, Hand Tools, Barrows, Wood and Metal Patterns, Time Recorder; Board Room and Office Furniture, etc., etc.

For printed particulars, permits to view and to inspect the Schedule of the Plant, etc., apply to the AUCTIONEERS, Clarence Buildings, 2, Booth Street, Manchester (Tel. Central 3668) and Central Chambers, Bolton (Tel. 181); R. SMETHURST, ESQ., the Liquidator, Messrs. GRIERSON, SONS & SMETHURST, Chartered Accountants, 21, Spring Gardens, Manchester (Tel. City 1814); or to Messrs. BROWNSWORD & ARNOLD, Solicitors, 86, King Street, Manchester (Tel. Central 4552).

MACHINERY.

MACHINERY PLANT, &c., FOR SALE.

SINGLE-ENDED PUNCH AND SHEARS, by Stirk, to punch and shear ⅝ in. by ⅜ in., 12-in gaps.

Two No. 14 DOUBLE-ENDED GRINDING MACHINES, by Besly & Company, tables 12½ in. x 10 in.

12-in. stroke CRANK SHAPING MACHINE, by Hodgkins, traversing head and swivel tool box, T-slotted table 17 in. x 15 in. x 12 in.

Five 36-in. Motor-driven VENTILATING FANS, by Keith Blackman.

LANCASHIRE BOILER, 30 ft. x 8 ft., reinsure 100-lbs. pressure.

Two LANCASHIRE BOILERS, 30 ft. x 7 ft. 6 in., reinsure 150-lbs. pressure.

SEVERAL HUNDREDS OF TANKS, rectangular and circular, 10-gallons capacity upwards.

One first-class No. 6 "Ruston-Hornsby" Crane-type STEAM NAVVY, on caterpillar tracks, splendid working order, cheap for prompt clearance from site.

40-ton "POOLEY" WAGON WEIGHBRIDGE, platform 22-ft. long x 6-ft. 6-in. wide, 4-ft. 8½-in. gauge rails, no loose weight steelyard.

DOUBLE CYLINDER HORIZONTAL STEAM WINCHES, single and double purchase type, with cylinders 4½-in. to 10-in. dia., extremely large variety.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS. W. WARD LTD.,
ALBION WORKS, SHEFFIELD.

MACHINERY.—*Continued.*

WANTED, a Cupola Fan or Blower, in good second-hand condition.—Box 572, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

'Phone 98 Staines.

WORTHINGTON STEAM-DRIVEN COMPRESSOR, 12 in. x 12 in. x 12 in.
REAVELL 4-CYL. COMPRESSOR, 5½ in. x 5½ in.
ARNOLD GOODWIN BELT-DRIVEN, 8 in. x 10 in.
THREE-THROW PLUNGER PUMP, 5½ in. x 8 in.
4 ft. 6 in. UNDER-DRIVEN SAND MILL.
HORIZONTAL DOUBLE CYLINDER STEAM WINCH, 4½ in. x 6 in.
HARRY H. GARDAM & CO., LIMITED, STAINES.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

CASTINGS WANTED.

ABOUT 20-30 TONS SPECIAL PIPES, D. Section, 3, 4 and 5 ft. lens, ⅜ in. metal; also 100 Box Castings, about 3 ft. 6 in. x 2 ft. 9 in. x 9 in; competitive prices wanted against drawings.—Box 570, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS.

MAUGHLIN PATTERN LETTERS AND FIGURES.—Die cast complete with pins in one piece, ready for fixing; no shellac required; simply drive them in and they will not come off; send for samples and prices.—A. LAKIN & SON, Totley Rise, Sheffield.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. 'Phone 264.

CHARCOAL.—Powdered, granulated, lump, blacking; inquiries invited.—J. BUCHANAN & COMPANY, Ashfield Road, Altrincham, Cheshire.

PARTING POWDER.—Have you tried ours? Efficient and cheap.—WM. OLSEN, LTD., Cogan Street, Hull.

PARTNERSHIP.

FOUNDRY.—Steel and Non-Ferrous, near London; old established; partner with influence and some capital wanted.—Write Box, FROST-SMITH ADVT. SERVICE, 64, Finsbury Pavement, E.C.2.

'Phone: 287 SLOUGH.

CRANE LADLES

½ TON (NEW), enclosed gear ..	£12
1 TON (NEW), enclosed gear ..	£20
3 TON EVANS, as new	£30
5 TON EVANS, as new	£36
8 TON EVANS, good	£40
10 TON STEVENSON, equal to new	£45
12 TON EVANS, equal to new ..	£65

All have Worm and Bevel Gear.

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND. PLEASE SEND FOR LISTS.

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH.